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The Outlook

Aircraft Propulsion

WHEN the first jet-propelled Gloster aircraft, the E.28/39, made its initial flight in May of 1941, it is very doubtful that anyone, even Air Commodore Whittle himself, would have ventured to prophesy that within five years it would be almost universally agreed that the piston engine was "dead" except for certain very limited uses. Yet that expression was used by a number of experts during the recent lectures and discussions at the Royal Aeronautical Society and other erudite bodies.

That progress has been amazing during those five years no one would deny, and that Great Britain has established a great lead over all others in this particular field is probably generally realized, although it may not always be openly admitted. It is, perhaps, but natural that, in view of these facts, there should be attempts to evaluate the relative merits of the different forms of gas turbine power plants and to forecast, from the results of the comparisons, which is likely to offer the greatest prospects of ousting the others.

To us it appears that such attempts are premature. On a basis of years of development they may be compared with the early flying days when we had such piston engines as the Green and Austro-Daimler water-cooled, the Anzani radial air-cooled and the Gnome and le Rhone rotaries. It would have been impossible to forecast from those early engines the development which was to result in such wonderful power plants as the Rolls-Royce Merlin and the Bristol Centaurus.

Do not let us forget that the air-cooled versus liquid-cooled controversy continued right up to the present day, or in other words, right up to the "death" of both types, if the turbine enthusiasts are to be believed. Similarly in the gas turbine field it may very well be that all types will survive and will undergo a comparable series of developments. Centrifugal and axial-flow compressors, plain turbojets, turbine-airscrew units, and the compound piston-turbine engine may all find their applications in different fields. It would be extremely unwise to neglect research and development of any of them.

Anglo-American Collaboration

DESPITE the strenuous efforts being made in certain American quarters to belittle any British achievement, there are healthy signs that at long last the great American public may be permitted to know something of what this little country has accomplished, and that it may even one day be told that the technicians of the two countries are still working closely together in several fields.

For example, the recent awards to Air Comdre. Frank Whittle of the U.S. Legion of Merit and the Daniel Guggenheim Medal will have made millions of Americans aware that at least one Englishman is deemed worthy of recognition in the jet-propulsion field. Of the presentation of the latter award the *New York Times* said that Whittle has taken his place among the great contributors to the science of flight.

The vast majority of the American public may still be unaware that the Taylor Turbine Corporation holds the licence to manufacture and distribute Rolls-Royce jets and turbines in the United States, but sooner or later the fact of the pre-eminence of this British product will have to be admitted, unpalatable as it may be to some.

We are not, of course, suggesting for one moment that Great Britain holds a monopoly in knowledge and experience. Very far from it. There are probably, if one looks around the whole aviation picture, quite as many things we can learn from the Americans as there are things they can learn from us. It was, if we remember right, Mr. J. D. North who said many years ago, in advocating the pooling of knowledge, that if ten aircraft designers of approximately equal skill and ex-

perience contributed to a common fund of knowledge, each would, on an average, stand to gain nine times as much as he gave.

Our English contributor in America, "Kibitzer," in his impressions of the Cleveland Show, refers to an interesting example of collaboration which has had very fruitful results. The Fairchild Naval Trainer has the U.S.-British standardized cockpit. This may seem a small matter, but it is one which may have very far-reaching results. There are many other directions in which standardization could be very beneficial. Each nation must be prepared to sacrifice something in order to achieve it, but the slight hurt to national pride is as nothing compared with the advantages to be gained.

Research Reorganization

THE history of flying has been closely linked with research. Only the very earliest pioneers had to rely almost entirely on their intuition and common sense in designing their aircraft, quantitative data being both scarce and of doubtful reliability. The Wright brothers were painfully aware of this, and very soon decided to build their own wind tunnel in order to get reliable data for their flying machine. In Europe the great Gustav Eiffel established an aerodynamic laboratory, and many of the early experimenters owed at least some of their successes (or perhaps it would be more to the point to say avoidance of complete failure) to his published works.

Since that time research has played an ever greater part in aeronautical progress, and the wind tunnel has become but one of many instruments of research, albeit still a very important one. With the advent of jet propulsion and flight at sonic and, before so very long, supersonic speeds, the problems confronting the aircraft designer have grown so formidable that only a very well organized and equipped research section will be able to keep this country in the forefront of nations.

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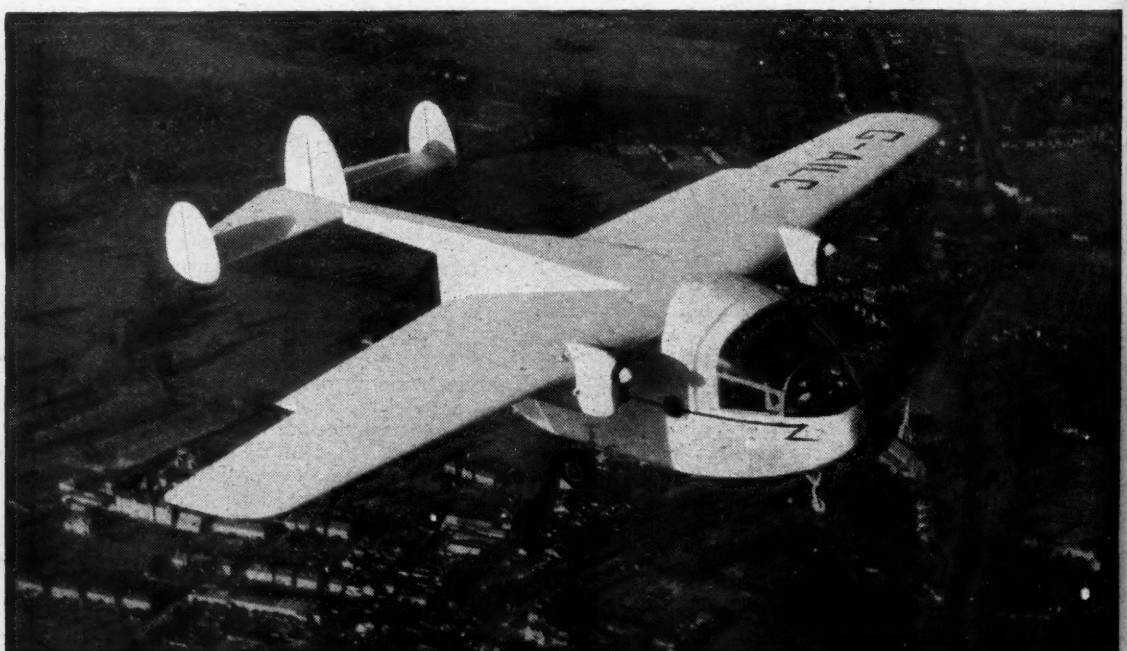
The announcement of the establishment of the National Research Establishment at Thurleigh was received with satisfaction, and now the official announcement that Sir Ben Lockspeiser has been appointed chief scientist to the Ministry of Supply is another indication of the Government's determination to build up a strong research organization. In his new post Sir Ben will be responsible for a much wider field of research than previously, and his wide experience qualifies him eminently for the greater responsibilities.

At the same time the Directorate of Scientific Research (Air) will be taken over by Mr. H. M. Garner and that of Technical Development (Air) by Mr. S. Scott-Hall. Both have been associated with technical progress for a great many years. Mr. Garner was at the Marine Aircraft Experimental Establishment at Felixstowe as Principal Scientific Officer for a long time between the wars, and Mr. Scott-Hall has had as many years in a rather similar capacity at Martlesham, as well as serving at Bawdsey, the R.A.E. and at headquarters.

All three appointments will be greeted with satisfaction by the aviation community, and *Flight* offers its sincere congratulations to the three new chiefs. We feel sure each will do well in his new sphere.



FOR PASSENGERS OR PARCELS: The Cirrus-engined Miles Aerovan Mk. V, which has a cruising speed of 112 m.p.h. and a landing speed of 46 m.p.h. Cabin volume is 530 cubic feet and range, with extra tanks, is about 800 miles.

Bridging the Gap

The Work of the Empire Test Pilots' School

Illustrated by "Flight" Photographs

TO stress once again the vital importance of the test pilot in the present stage of aeronautical progress and the necessity for him to be as knowledgeable as possible would be merely repetitive. In varying words these statements have been made on many occasions, and they have become axiomatic. The problem of how a millenial state of affairs could be made to come about was, unknown to all but a comparative few, tackled in 1943 or even earlier.

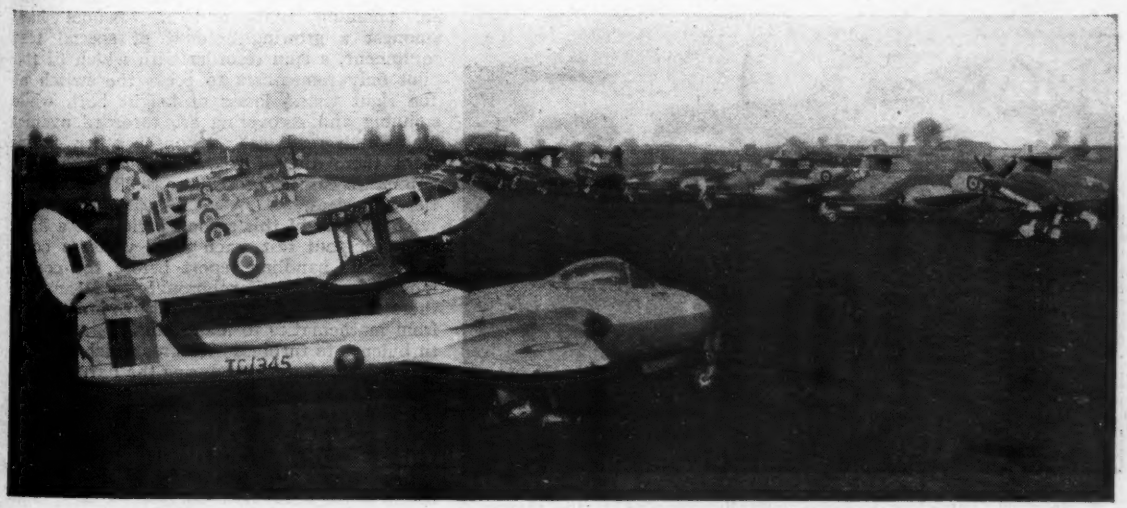
The E.T.P.S. is international and inter-service. Lt. Cdr. L. G. Kiggell, D.S.C., in the Meteor, is one of five R.N. students. On the left is Mr. J. C. Miles, of the Australian D.A.P.

The Ministry of Supply's Empire Test Pilots' School was then formed at Boscombe Down—to be transferred, at the end of last year, to its present situation at Cranfield where the fifth course is now in progress. Whether Cranfield will be the school's final home remains to be seen; although there are obvious advantages in sharing a station with the still embryonic College of Aeronautics, there might be greater advantages still if the School moved, say, to Farnborough, where, in any case, each course spends a month or more.

Quite apart from the obvious demand for technical knowledge and up-to-date experience in test pilots of modern aircraft, there are a number of other requirements. And it is over these that the E.T.P.S. course may be even more valuable. One which comes immediately to mind is the advantage of standardization in routine test procedure, both between the different pilots in a team and between the teams of the different factories and establishments. Such standardization, coupled with an accurate knowledge of the requirements, should do much to reduce the often unreasonable length of time taken over prototype development and even over the passing out of "rogue" production types. Lack of method and lack of a firm knowledge of aerodynamic effects may cause development to be something of a hit-or-miss affair, with technicians and pilots taking turns, so to speak, in the planning of the modifications.

Again, the balance of power between technicians and test pilots varies considerably, and full co-operation is by no means as usual as it should be. Standardized training will give both sides more confidence, while the course is intended to promote the exercise of both tact and patience, and will certainly produce higher standards in test reporting.

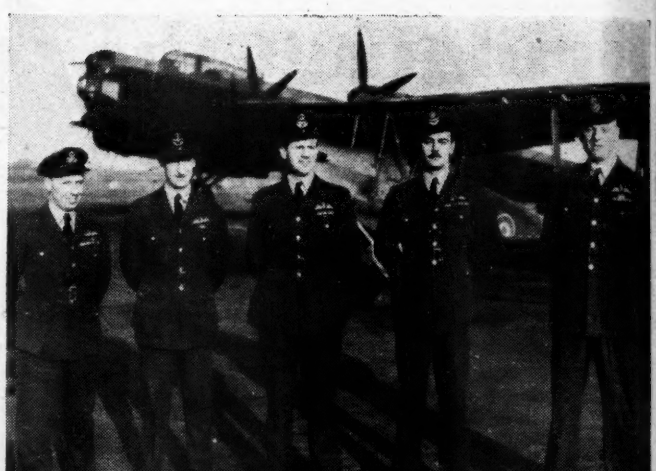
The fact that so many different aircraft types are used at the E.T.P.S. may be something of a worry to the pupil—unless he has been partly trained in the hard school of the M.U.s of the early war years, when anything up to



A line-up of the majority of the aircraft in the very wide range of types used on the E.T.P.S. course, with a D.H. Vampire in the foreground and the very useful communication Dominie behind it.

fifteen different types might be handled weekly. But only by such multiplication can desirable characteristics and requirements be thoroughly assessed. In the inevitable cheese-paring years after a war, it was comforting to find the School so well-blessed with the latest types—including jet fighters with interesting compressibility reactions, the latest conventional bomber types and even a contra-prop fighter. Unfortunately, like all R.A.F. units, the School suffers from a lack of basic man-power and from consequent serviceability problems. And, naturally, it all costs rather a lot of money.

Since it is the only school of its kind in the world, there is, amongst the pupils of each course, a very fair sprinkling of pilots from other countries and dominions, as well as the three civilian test-pilot pupils from firms in this country. Incidentally, one feels that this last is a somewhat meagre number—particularly as all initial prototype flying, both of military and civil types, is carried out by civilians. Of the thirty-five students on the fifth course, five are from the Navy and as many as sixteen from the Air Force. Since a G.D. officer must be trained, in the course of his career, to be eligible for high rank and go, for instance, through the mill of obtaining administrative experience, he can rarely remain a specialist. In many cases, therefore, the concentrated training and experience obtained by a service test pilot must inevitably be thrown away—for, in these days, test flying is work on which one must be in week-to-week practice and with up-to-the-minute experience. Which suggests that the high proportion of R.A.F. officers in the total number of pupils on the course may be designed to allow for wastage, and that the Air Council may eventually need to reconsider the specialist question in the particular case of test pilots.



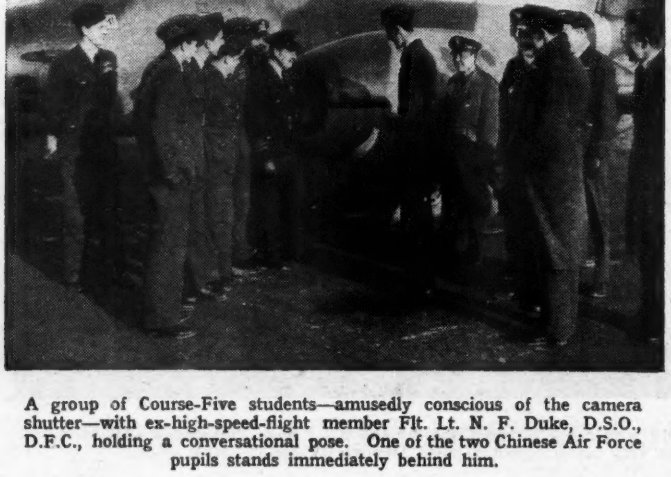
Five of the "flying" instructional staff at Cranfield—Sqn. Ldr. R. E. Havercroft, Sqn. Ldr. H. Hobley, A.F.C., Wing Cdr. R. L. Smith (O.C. Flying), Flt. Lt. P. F. Wingate, D.F.C., and Sqn. Ldr. K. J. Sewell, D.F.M. The chief technical instructor is Mr. G. MacLaren Humphreys, and the School is commanded by Group Capt. H. J. Wilson, O.B.E., A.F.C.

The E.T.P.S. course covers a total period of more than nine months—an apposite gestation time—of which seven are spent "at school." The remaining months are divided equally between a "tour" at the R.A.E., Farnborough, and a round of the aircraft industry. The Cranfield time is also divided equally into two periods.

During the first of these the pupils might be said to be dealing with "quantitative" test procedure and during the second with "qualitative" testing. In other words, the first period is mainly devoted to the study of principles and to the practice of simple performance testing—the routine side of aircraft test work in which figures and more figures must be brought back for the enlightenment of technicians.

In the School at Cranfield the pupils do not merely bring back a series of recorded figures for "partials" and "levels," leaving the rest to the technician's guessing-stick; they work out all their own conversions. The figures are, in fact, reduced to "standard" and the appropriate lessons drawn. From the measurement of A.S.I. position errors to the checking of asymmetric performance figures, the pupil is taught to be his own technician.

On the "qualitative" or handling side he is taught to judge the merits and de-merits of different aircraft in different situations. He learns, in fact, to judge the handling and stability tolerances allowable with various classes of aircraft and to deal with trimming defects. Included in this part of the course are spinning trials and the School has, amongst a growing amount of special test equipment, a spin recorder with which (if the pilot only remembers to press the switch at the right times) losses of height both while spinning and recovering are recorded against stop-watch readings. Amongst other equipment there are, of course, the now familiar automatic camera recorders of different varieties and sizes.



A group of Course-Five students—amusedly conscious of the camera shutter—with ex-high-speed-flight member Flt. Lt. N. F. Duke, D.S.O., D.F.C., holding a conversational pose. One of the two Chinese Air Force pupils stands immediately behind him.

At the end of this second period, as a kind of passing-out test, each pupil writes a comprehensive handling report before the course moves on to Farnborough. Meanwhile there have been a series of lectures on subjects from mathematics to Mach number, and from turbulence to turbines—lectures which are considerably supplemented during the Farnborough visit.

Finally, at the factories, the students have the chance of meeting the real thing—and the real people.

After completing the course, a pilot should, in the words of Sir Alec Coryton, be able to go to a foreign country, fly a strange aircraft of any type, and complete an authoritive test report without technical assistance.

Britain's Test Pilots

No. 17—Wing Cdr. Reginald Alfred Charles Brie, A.F.Inst.A.E.S. (Amer.)

IN the strictest sense of the words, Reggie Brie is not a test pilot. All the prototype flying of Autogiros was done by the late Don Juan de la Cierva aided in the early days by Frank Courtney, and later by H. A. Marsh. It is fair to say, however, that Brie has tested the possibilities of rotating-wing aircraft to a far greater extent, perhaps, than any other person in the world. On the uses and limitations of the Autogiro and helicopter he is an undoubted authority.

His first interest in aircraft, with either fixed or rotary wings, came when as a lad of 14, he read newspaper accounts of the Rheims meeting in 1909. Later he saw Lee Temple force-land a Bleriot at Uxbridge near his home, and he then started attending the flying meetings held each week-end at Hendon before the 1914-18 war. At one time he thought of getting into the balloon section of the R.F.C., but his parents though otherwise and he was apprenticed to a firm of electrical engineers at Southall.

Like many a young man of his generation, as soon as the war came in August, 1914, he was over-anxious to get into uniform. The Royal Flying Corps told him he would have to wait six weeks so, rather than be too late for the war, he promptly joined the Royal Field Artillery and was serving in France early in 1915. Later he was moved to Salonika and, because he knew most of the aircraft of that time, he became the battery spotter. With the rank of sergeant he was then recommended for a commission and sent back to England for training.

Whilst in England he transferred to the R.F.C. and, because of his gunner's experience, trained as an observer. After months of flying in the back seats of Brisfits and the front seats of F.E.2bs, and having at the same time struggled fairly successfully with the Douglas protractor and Norman compensating foresight, he was posted to No. 104 Squadron, at Andover, under Major J. C. Quinnell.

A recent *Flight* photograph of Wing Cdr. Brie and (below) taking a Sikorsky R.4 helicopter off from a small platform on the deck of S.S. *Daghestan* in 1944.

Kollege Of 'Kopter Knowledge
BE IT KNOWN BY THESE CONTENTS
THAT
Reggie A. C. Brie W/C.
HAVING REMAINED MOTIONLESS IN SPACE, FLOWN FORWARD, BACKWARD, SIDEWARD, AND VERTICALLY, WITHOUT SERIOUS CONSEQUENCES,
IS AWARDED THIS CERTIFICATE FOR SUCCESSFUL COMPLETION
OF THE
HELICOPTER PILOT TRAINING COURSE
ON THIS SIXTH DAY OF SEPTEMBER 1944
AND IS DULY ACKNOWLEDGED
TO BE A GENUINE HOVERBUG
(HONORARY)
JOHN A. SAYOUSKI, Major, A.C.
CHIEF INSTRUCTOR
WILLIAM H. KING, Capt., A.C.
INSTRUCTOR
SEAL
FREEMAN FIELD, SEYMOUR, INDIANA.

HONORARY HOVERBUG: The certificate of proficiency awarded Brie at Freeman Field, Indiana.

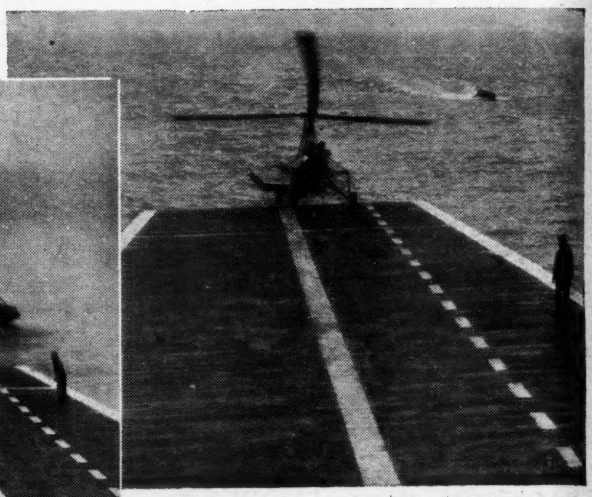
In May, 1918, the squadron flew its D.H.9s over to Azelot, near Nancy, and became part of the Independent Air Force, which can be considered the forerunner of Bomber Command. A 230-pounder was the largest bomb carried on the D.H.9, and it was customary for the observer to carry a 20lb Cooper bomb with him.

Prisoner of War

An early morning raid at this time nearly robbed the helicopter world of its super-enthusiast. The unescorted D.H.9s were picked up at about 8,000ft by six Pfalz fighters, which opened fire from long range. Brie heard his pilot shout, and saw steam coming from the Siddeley Puma engine, which immediately lost power. It was fortunate for Reggie that the Germans paid all their attention to another D.H.9 which had also been hit, and a forced landing was made on a hayfield, the aircraft turning over and throwing Brie out. After releasing the pilot from his inverted perch, the "Nine" was set alight by a Very's cartridge, just as a very elderly "hun" came up to take them prisoner. For the next four months Reggie languished as a prisoner of war in five camps, being released just in time to get home on Christmas Day, 1918.

His next posting was to No. 2 Group, at Merton College, Oxford, as Transport Officer. Two of his commanding officers here were Lt. Col. Freeman (now Sir Wilfred) and Lt. Col. Philip Joubert (now Air Chief Marshal and Chief of Public Relations, Air Ministry). In September, 1919, he was granted a short-service commission and, in December of the same year, went to Risalpur to join No. 99 Squadron, which was later re-numbered No. 27. After a very short stay, Brie found himself back in England—

BRITAIN'S TEST PILOTS



(Top left) Landing across the 30ft-wide platform of the *Fiume* in Spezia harbour and (above) creeping over the end of *Fiume's* platform while the cruiser was under way. The photograph on the left was taken during the deck-landing trials of the Pitcairn P.A.39 on S.S. *Empire Mersey* in Chesapeake Bay in May 1942.

still with the rank of Flying Officer—on the Inspectorate of Recruiting.

Eventually Reggie got his desire and, in August, 1921, he took a pilot's course at Leuchars, going solo after 10 hours dual. One of his instructors was F/O T. M. Williams (now an Air Vice-Marshal and Assistant C.A.S.). After a further year in the Service, he went on the R.A.F. Reserve—and is still on it, 24 years later.

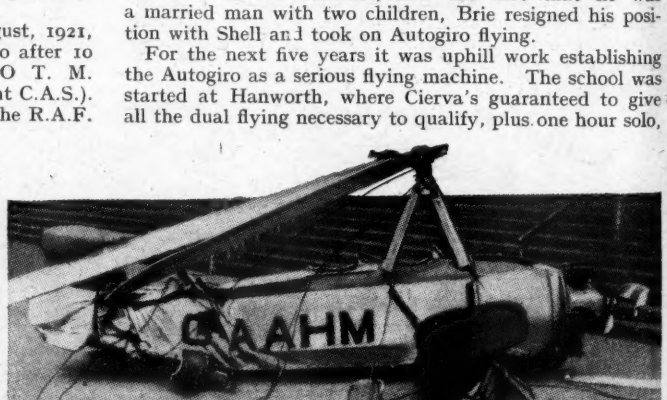
For eight years Brie was with the Shell company as a salesman of petroleum products, but, of course, he still did the necessary 12 hours' flying per annum required by the R.A.F. Reserve. Most of this he did at the de Havilland School of Flying at Stag Lane.

It was on a reserve-flying flight that he was nearly "written off" for the second time. Flying a Jaguar-engined D.H.9a on a flight to Duxford, the weather went back on him, and landing in a panic near Aldenham, he ran into a wood and wrote everything off except himself. He was later found wandering in the dark some way from the crash, and was driven home by Clement Pike who was then one of D.H.'s new instructors, and who now runs the D.H. school at Panshanger.

Still keen on flying, he then took out his B-licence with the idea of doing week-end joy riding. This licence is still current, but restricted to rotating-wing aircraft. His crash, and another experience on a mono Avro, made him want to solve the problem of flying slowly, and he remembered the Autogiro with its ability to touch-down with practically no forward run.

Reggie went to Heston to see it perform, and got permission from Cierva to have a flight with Baker, who was then demonstrating it. Later "Dizzy" Rawson, another Autogiro pilot, gave Brie 30 minutes dual on a C.19, after which he was allowed to go solo. The outcome of his keenness was an offer by Air Commodore J. G. Weir—who largely financed Cierva—of a job for three months and the immediate task of taking an Autogiro to a meeting at Orly, near Paris. Despite the shortness of the contract, and the fact that he was a married man with two children, Brie resigned his position with Shell and took on Autogiro flying.

For the next five years it was uphill work establishing the Autogiro as a serious flying machine. The school was started at Hanworth, where Cierva's guaranteed to give all the dual flying necessary to qualify, plus one hour solo,



The C.19 Mk. IV after Brie had flown it into 14 electric light cables at the White City.

for £5. The C.19 gave way to the C.30 which had direct control of the rotor and no fixed wings.

In 1933, to demonstrate its possibilities and also as a stunt, Brie was asked to land an Autogiro in the stadium at the White City and fly it off again. Just to make sure all would be well, he did a dummy run the day before. This was just as well because in the take-off he got mixed up with 14 electric light cables which brought him to a standstill and he executed a very vertical descent, which might easily have proved disastrous.

The same year he did some rather more serious work with the army on manoeuvres. His passengers included General Wavell, and he had to put the Autogiro down and take it off from some incredible places.

In December, 1935, Brie went on the first of his missionary projects abroad with the Autogiro. He contracted with the Italian Navy to land on and take off from a 90ft × 30ft platform built over the quarter deck of the cruiser *Fiume*. Landings were to be made both while the ship was stationary in Spezia harbour and also whilst it was under way at sea. This was accomplished satisfactorily if a trifle "emotioningly." The landing in harbour was with the ship across the wind and at sea the *Fiume* was steamed at 18½ knots, and Brie had a passenger on board. Attempting to cut it as fine as possible, he caught his tail on the after edge of the platform.

. . . . Everything was written off except Reggie. The remains of the Jaguar D.H.9a after Brie had crashed in a wood near Aldenham.

Later in 1935 he made the first rotating-wing landing on an aircraft carrier—*H.M.S. Furious*. This was only just accomplished because the wind over the flight deck in this case was too high and he had the greatest difficulty in getting down at all.

In 1938 the jump-start C.40 Autogiro was produced and all sorts of new possibilities became apparent. He demonstrated it before many people, including the officers of the Army Staff College at Camberley—General Paget was one of his passengers. Shortly before the outbreak of war in 1939 I, also, had the pleasure and thrill of being flown by him in and out of a sand pit—what was then the smallest airfield in the world.

Radar Calibration

On the second day of the war Brie was told to prepare to go to France with Autogiros for the personal use of Lord Gort, but some jealousy between government departments defeated this project and orders were cancelled. In December, however, he was asked to take on something which probably had a very direct effect on the outcome of the Battle of Britain. Working with Dr. Kinsey he spent many hours flying round the coasts of Britain for radar calibration. For the same purpose he later formed No. 529 Autogiro Squadron and many hours' flying were put in, mostly over the sea with no escort or armament. In this work he was aided by Gilbert Elliott and Guy Turner, who were both amateur pilots of Autogiros.

May of 1941 found him on a totally different project. This time it was to run a technical development unit at the Central Landing Establishment of Airborne Forces. He was associated with Dr. J. J. Bennett, Nigel Norman and the redoubtable Louis Strange. Their special task was to develop special equipment for airborne troops and commandos. The Autochute was one of many devices tried out at the Establishment. Reggie's next task was to go to America at the behest of the Admiralty to put the Pitcairn Autogiro (P.A.39), a direct take-off jumper, through its trials. Seven of these were on order for us. With this type, on May 12 and 13, 1942, he made the first landings on a British merchant ship— the *S.S. Empire Mersey*, of 10,000 tons. The platform was only 80ft × 40ft. Air Marshal Sir Roderic Hill insisted on flying with him on the trials.

Whilst in America his energies became devoted to helicopters, which, after all, are the logical development of the Autogiro. His first contact with these occurred when Les Morris, chief test pilot of Sikorskys, invited him to see a film of the now old V.S.300. He was so intrigued that he saw the film through twice and missed his train back in consequence. He realized how much the ability to hover would help in shipboard use, and it was as an anti-submarine device that the helicopter was most wanted. To this end Brie then devoted all his energies to the rotary-wing activities of the British Air Commission in America. This might have proved a big job, but as it turned out, the order for 250 Sikorsky R.4s was cancelled. Nevertheless, during 1943, he ran the first helicopter school in America and made the first deck-landing trials with the R.4 on *S.S.Daghestan* in 1944. Likewise he, with Sqn. Ldr. F. J. Cable, did the first convoy trip with helicopters as anti-U-boat aircraft, and on arrival at Liverpool jumped off the deck and landed at Speke airport. Later they flew on down to Hanworth.

After another trip to America he spent a short while in 1945 attached to the rotary-wing section of the Directorate of Technical Development, and after being demobilized was with the Fairey Aircraft Company for a brief period. He is now a consultant.

Brie has 2,875 flying hours in his log book, on 10 fixed-wing and 10 rotating-wing types. Of these hours 2,149 are on Autogiros and 116 on helicopters. He is a charter member of the Helicopter Society in America and a founder member of the helicopter Association of Great Britain.

J. Y.

From a lecture by R. G. Robertson, B.A., before Aerotech.

HERE AND THERE

ANYONE AT HOME? Geoffrey Tyson brings the Short Solent in *really* close to the Percival Proctor in which *Flight's* cameraman is flying. Other photographs of the Solent appear on pages 650 a & b.

Heaven-sent Business?

THE following extract will give you some idea of the greatly extended scope of the British export drive. It is taken from the news bulletin issued by a well known firm of component manufacturers.

"We are proud to announce the receipt of a contract from the makers of these two famous motor cycle manufacturers . . ."

Divine intervention indeed!

Model Show Opens To-day

BRITAIN'S third National Model Aircraft Exhibition is being opened at 12.30 p.m. to-day, December 12th, by Mr. Philip Noel-Baker, at Dorland Hall, Lower Regent Street, London, W.1, and it will contain nearly 1,000 models which represent the cream of an entry many times that number.

The value and importance of the designing and building of model aircraft has often been acknowledged in *Flight*, and what began as merely a hobby has now attained such significance that the Air Ministry recognises it as a training ground for future aeronautical engineers and gives its blessing to this annual venture.

The exhibition is organized jointly by the *Aeromodeller* and the *Daily Express*, and will remain open for just over a month—until Saturday, January 11th next.

The prizes won by exhibitors amount in value to over £500, and one of the exhibits (which are collectively insured for £25,000) comes from Australia.

Honoured by the U.S.

COMMENTING last week upon the award to Air Comdre. Frank Whittle of the Daniel Guggenheim Medal for achievements in aeronautics, the *New York Times* paid a generous but fully merited tribute to its recipient and said, "Air Comdre. Whittle, the British jet propulsion pioneer, takes his place among the great contributors to the science of flight."

First announcement of this award to Whittle, together with the U.S. Legion of Merit, Degree of Commander, was made in *Flight*, November 7th, and a picture of his receiving the latter decoration from Lt. Gen. Ira C. Eaker, Chief of Air Staff, at Washington, appeared in *Flight*, November 28th.

First "Jet" Show

BRITAIN'S first exhibition devoted to the gas turbine is to be opened by the Minister of Supply, Mr. John Wilmot, at Charing Cross Underground Station on Monday, December 16th, and will remain open until January 3rd.

This exhibition aims at explaining to the public, by means of a display of actual engines, models, and photographs, the main principles behind the gas turbine, and such aspects as its development and the effects on aircraft design.

Actual engines on show will include the Nene, Ghost, Mamba, and F2/3, while among the various models will be that of a hypothetical aircraft of the future which aroused considerable interest at the Paris show last month.

Research at Westlands

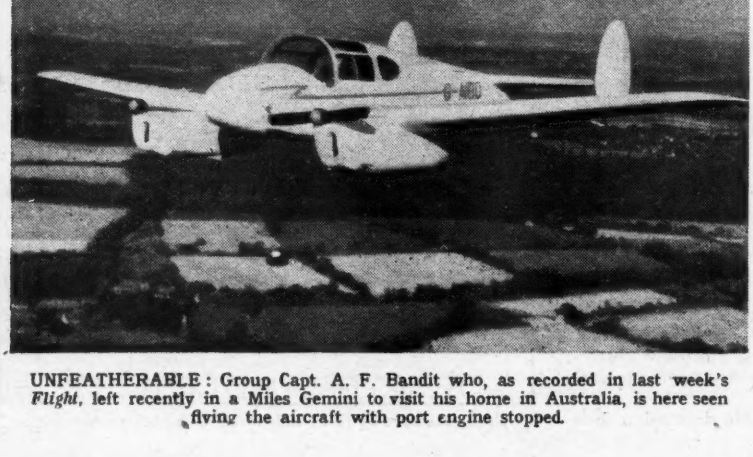
REFERENCE to research and development work, more especially in connection with high altitude flight, was made by Lord Aberconway, chairman of Westland Aircraft, Ltd., at the firm's 11th ordinary general meeting in London last week.

This work, he said, continued to occupy an important place in the activities of the company and from it had come the successful development of equipment providing passenger comfort in respect of atmospheric pressure and temperature in high-flying airliners. Extension of this phase of research and its commercial development was now being carried on by their subsidiary, Normalair, Ltd.

To Direct Atomic Research

DR. W. B. LEWIS, prominent British nuclear scientist, is to be Director of Scientific Research at the atomic energy plant at Deep River, Ontario.

Dr. Lewis was one of the original Cambridge team working on nuclear physics and was appointed chief of the Radar Research Establishment at Malvern College in November of last year. He was formerly university lecturer in physics at the Cavendish laboratory where the original atom-splitting experi-



UNFEATHERABLE: Group Capt. A. F. Bandit who, as recorded in last week's *Flight*, left recently in a Miles Gemini to visit his home in Australia, is here seen flying the aircraft with port engine stopped.

HERE AND THERE

ments were carried out, but since 1939 has been wholly employed on radar research.

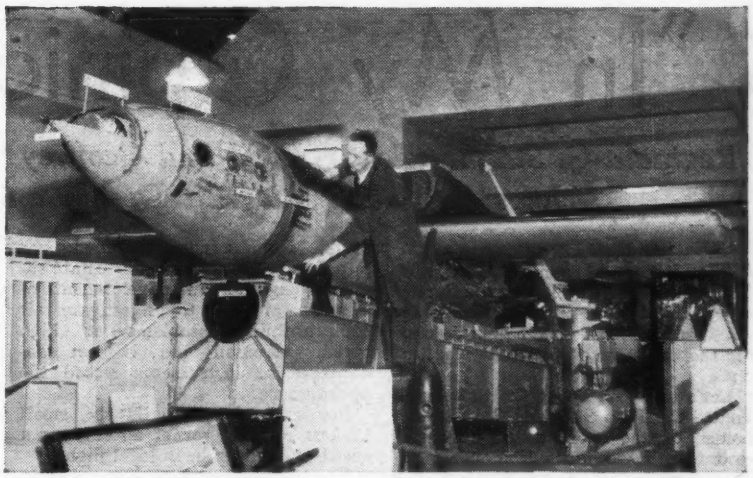
In the June birthday honours this year, Dr. Lewis was awarded the C.B.E.

Shannon Sideshow

THE despatch of Irish racehorses to America by air, mentioned in "Here and There" recently, seems to have created quite a stir at Shannon Airport, where some 300 spectators are reported to have gathered to see the £50,000-worth of thoroughbreds off on their 6,000-mile flight.

The departure had been delayed by bad weather, and only six horses were sent, not eight as originally intended, their destination being Los Angeles with a refuelling stop at New York.

Incidentally, a special crane is said to have been built to load the animals, one of which was somewhat significantly named *Great Faith.*



WAR "SECRETS," such as this German flying bomb, are now on view at the re-opened Imperial War Museum. The "doodle bug" became all too familiar, but the launching cradle is of interest. Another museum picture is on page 660.

News in Brief

SWISS radio announced last week the introduction, shortly, of an additional air service between Basle and London to deal with the increased tourist traffic during the winter sports season.

* * *

Mr. Roy Chadwick, the celebrated Avro designer; Professor J. D. Cockcroft, research expert in atomics; and Sir H. Hartley, of the B.O.A.C., were made Honorary Associates of the College of Technology, Manchester, on November 30th.

* * *

The new air training squadron attached to Manchester University which operates from Barton Airport has recently received its third Tiger Moth from the R.A.F. The squadron has nearly 50 members, whose average age is 18½ years.

* * *

More than 600,000 visitors saw the Paris Aero Show, which closed on December 1st after being open for just over a fortnight. Figures recently published show that commercial aircraft attracted the largest number of buyers, and orders booked are reported to run into several thousand.

* * *

The *British Standards Institution Yearbook*, which has just been published, gives a subject index and a synopsis of each of the 1,300 British standards now current. These have been prepared by committees of 44 different industries, and the book is priced at 2s (including postage) from the Institution's publications sales department, at 28, Victoria Street, London, S.W.1.

* * *

The Board of Trade announce that the Standards Department has left Blackpool and that the address is now Chapter Street House, Chapter Street, London, S.W.1 (Tel.: Victoria 7032).

* * *

The last Handley Page Halifax, a Mark A9, was recently delivered to the R.A.F. and will be operated by the Airborne Forces. More than 6,000 Halifaxes have been produced since 1939, and 26 versions of the original type were developed for a variety of combat duties.

* * *

Yet another firm—Freemantle Overseas Radio—is making use of private aircraft as a means of business transport. They have a Percival Q.6, and a second machine may be purchased shortly. Their European representative, incidentally, is Mr. John Rogers, who, since 1940, had been a test pilot at General Aircraft.

* * *

Wing Cdr. D. B. Bennett, D.F.C., has joined W. A. Rollason, Ltd., as sales manager, replacing Mr. Bonar who has gone to International Airways, Ltd., and will control the firm's sales division from Croydon Airport.

* * *

Mr. Charles Nesling has resigned his position as senior industrial liaison officer of the Council of Industrial Design and has joined Allen-Bowden, Ltd., at their London offices at 4, Lygon Place, S.W.1.

Mr. L. G. Harris has resigned his post as secretary of Simmonds Aerocessories, Ltd., and associated companies, and has now joined the board of Small Electric Motors, Ltd., of Beckenham, Kent.

* * *

Mr. L. H. Maidman, secretary of Specialloid, Ltd., and a director of Specialloid (Canada), Ltd., has now been appointed to the board of the former company.

* * *

Mr. C. M. Squarey, "Cook's" overseas traffic manager, has flown to South Africa on a six weeks' tour of all the main cities of the Union to study at first hand all the present-day problems connected with tourism, and to acquaint himself with local circumstances.

* * *

Mr. A. L. Nickerson, who was chairman of the Vacuum Oil Co., Ltd., until recently, has now been elected to the board of directors of Socony-Vacuum Oil Co., Inc., New York.

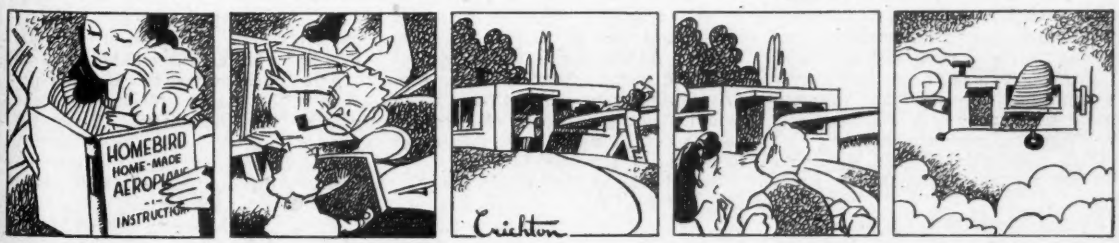
* * *

Cellon, Ltd., Kingston-on-Thames, who have given holidays with full pay to all their employees since 1918, have now adopted the five-day week and are therefore closed on Saturdays.

* * *

A new branch office has recently been opened at 59, Queen Square, Bristol, 1, by the Hoffmann Manufacturing Co., Ltd., and will be under the control of a qualified ball and roller bearing engineer.

AIRSTRIP . . . No. 43



"In My Opinion . . . . . "

Reginald G. Standerwick (G.E.C.) and Geoffrey Smith (Flight) Compare Notes on Future Aircraft Design and Propulsion

LAST Thursday evening a two-way talk over the Atlantic was arranged by American invitation between Mr. Reginald G. Standerwick, chief engineer aircraft gas turbine division of the General Electric Co. and Mr. Geoffrey Smith, Editorial Director of "Flight." The subject was "Aircraft of the Future and their Power Units" and the talk was featured in the series "In My Opinion" by the Columbia Broadcasting System.

It had been arranged to "pipe in" the discussion at the Joint Dinner of the American Rocket Society and the American Society of Mechanical Engineers held at the Pennsylvania Hotel, New York.

In introducing the speakers, mention was made by the announcer of Mr. Geoffrey Smith's book, "GAS TURBINES AND JET PROPULSION FOR AIRCRAFT." This has become the standard work of reference in the U.S.A.

STANDERWICK:

THE speed of sound is 760 m.p.h. If I could tell what I know about the preparations going on, this broadcast would rank as one of the most exciting and lengthy ones.

Let's talk first about the thoroughbreds—the P.80 Shooting Star is the holder of the world's long-distance record of 2,470 miles from coast to coast here, at 584.6 m.p.h., and it's already crowding your Gloster Meteor record of 616 m.p.h. established last September 8th. There's the Republic P.84, with a yet undisclosed record, but it's said to be faster yet. Yesterday I peeked behind the doors of the Army Airforce's jet stable, and I tell you it's bewildering. First, there's the line up of bombers of the 40 class and fighters of the 80 class. All I can say is that our speeds are going right up to XZ-1, and the predictions for this plane are really fantastic. Our Army Airforce is predicting speeds to begin at 600 m.p.h., then accelerating by stages to 1,000, 1,500 and even 1,700 m.p.h. for this plane. What's more, one of our latest models will climb twenty miles high in one minute. At the end of two minutes, its speed is so fast that if the power is turned off it will soar vertically for another twenty miles without power. That's supersonic or super-something.

Now, Smith, what is Britain doing about this invasion of supersonic heights? How soon?

Flying Missiles

SMITH:

An imaginative and sensational programme, Mr. Standerwick. But the fantastic speeds you quote must be for war weapons or flying missiles, as no human frame could stand such acceleration.

Now you ask my view as to whether we shall soon exceed the speed of sound.

With piloted aircraft, I would answer, not for a year or two. We have the necessary power in gas turbines, rocket propulsion and ramjets, which are going ahead amazingly fast, but aircraft design has not advanced in unison. Air compresses into a wall at transonic speeds and presents serious problems which affect control. Patiently they are being solved.

With pilotless craft it's different. We are on the threshold of 1,000 m.p.h.

As you know, rocket missiles have already far exceeded the speed of sound. The V.2 indeed attained 3,000 m.p.h. We have research establishments engaged on development of pilotless aircraft to investigate air compressibility problems at high speed. Human life is not endangered as instruments record the performance.

For example, there is the small Vickers pilotless rocket aircraft for a speed of 880 m.p.h. in level flight.

Knowledge gained will be applied to the design of piloted aircraft. With assisted take-off, ramjet planes will give a flash performance of over 1,000 m.p.h., but at tremendous fuel consumption.

1000 k.p.h. Achieved

As to British aircraft, to-day our fastest pursuit plane is the Meteor, which holds the world's record at 616 m.p.h., and during tests exceeded 1,000 k.p.h. With two Derwent jet units producing 8,000 lb thrust it has a phenomenal rate of climb—30,000ft in three minutes.

Imagine reaching the top of Everest, the world's highest mountain, in 180 seconds.

We are wholeheartedly committed to gas turbines. We have in regular production jets developing 5,000 lb thrust. At 600 m.p.h. this is equivalent to a piston engine of 16,000 h.p. driving a propeller which at that speed would have an estimated efficiency of 50 per cent. Eight horse-power per lb weight is almost unbelievable.

Now I should like to ask you, Mr. Standerwick, when do you in the United States expect to have jet-propelled passenger planes in the air?

STANDERWICK:

Commercial planes will follow the bomber class, and that's where the experience gained by our 40 class is expected to pay off. I refer to the XB-43 Douglas Bomber, which is powered by two General Electric J35 gas turbine engines, giving a total thrust of 8,000 lb, or the Flying Wing XB-49 Northrop, which is similar to the B-35 Flying Wing, except that it will have eight of our J-35 engines producing 32,000 lb thrust. I also expect the C-99 Consolidated Vultee will be converted to jets before very long. This plane is capable of carrying four hundred soldiers or three hundred and thirty-five patients. Actually it can take up a medium tank and its entire crew.

Thin Wings Expected

As to the appearance of these planes; as speeds increase the wings will become thinner and sharper in design. They'll be swept back or even swept forward, with or without tails. In fact, I think it's highly possible that the fuselage will take on the appearance of a high-velocity bullet to cut the sonic wall into the high speeds and altitudes. Fortunately, we will be fully prepared with suitable engines for high power and supersonic operation. I predict that before long, engines of five, ten, twenty or even fifty thousand pounds thrust will be the order of the day.

And what do you have to report along these lines, Mr. Smith?

SMITH:

Some new type aircraft that will interest you are a Saunders-Roe fighter flying boat with two Metro-Vick axial flow turbo-jets, an improved Vickers Spiteful with the Rolls-Royce Nene of 5,000 lb thrust, a flying wing by Armstrong Whitworth with two Nene turbo-jets, others with wings of arrowhead or boomerang form.

As to large transports we feel there has been too much easy optimism about speed. Commercially to reap the advantages offered by jet propulsion, it is imperative to fly very high and very fast, say, 50,000ft and 500 m.p.h. This entails reliable pressure cabins and improved aerodynamic design. The larger the aircraft, the greater the difficulties. Thus the pure jet airliners must await further technical progress. In the interim, turbines driving airscrews will power our Phase 1 airliners.

To-day, with piston engines, operating schedules are around 250-300

A TWO-WAY TRANSATLANTIC BROADCAST

m.p.h. at 20,000ft. To add 150 m.p.h. to present economic cruising speeds will be an accomplishment, and that is taking a realistic rather than a fanciful view.

Weather conditions are more stable in the stratosphere, but at lower altitudes passengers flying at, say, 500 m.p.h. in turbulent air would be distinctly uncomfortable. Ultra fast speeds at low heights may have to be ruled out except on fighters and bombers.

On the Lancaster Nene

You will have heard of our Lancastrian 14-seater airliner propelled by two Nene jets and two Merlin piston engines. It first flew last August. This 50-50 aircraft of 62,570 lb has already demonstrated to hundreds of passengers that turbines are far smoother and far quieter than piston engines. It is a revelation. On the two jets alone it will cruise at 260 m.p.h. at 10,000 ft, and at 330 m.p.h. with all four engines.

Next year Britain will have in the air a four-jet Tudor liner with an estimated cruising speed of 400 m.p.h., and it will be followed by several commercial liners with turbo-propellers. Our most ambitious project is the Bristol 167 weighing 145 tons, destined for the London-New York nonstop service; a Queen Elizabeth of the air to carry 132 passengers. It will have eight turbines geared in pairs, driving contra-rotating propellers. Each turbine and airscrew will operate independently of its companion, is desired. This leviathan of 230ft span will be in service by 1950, but prototypes will be flying long before that.

Then there is the 123ft span Handley Page Hermes with four Bristol Theseus turbo-props. Designed to carry 63 passengers, its all-up weight is 42 tons. A new de Havilland type will have four Ghost turbine jets, each of 20,000 lb thrust. A Miles Marathon 18-seater has Armstrong Siddeley Mamba turbo-prop units. There are also in the design stage aircraft with six turbines.

As to reliability the R.A.F. recently fixed the period between overhauls of Rolls-Royce jet engines at 270 hours. Even at a modest average of 400 m.p.h. this is equivalent to a distance of four times round the world. Successful metallurgical research is the secret.

Turbine powers continue to grow. We are developing units up to 10,000 lb thrust. Current military types have centrifugal compressors but for commercial operation the accent is on axial flow compressors. These enable higher compression ratios and the slim proportions permit enclosure within the wing.

Another phase of development is the compounded engine wherein a two-stroke Diesel engine is interposed between the compressor and turbine in order to burn the fuel more efficiently at a higher ratio of compression. Extreme economy, as low as .32 lb per h.p. hour offers the possibility of ranges of over 7,000 miles where high speed is not the main objective.

To sum up, the short-term policy on commercial aircraft is axial flow turbine driven propellers for medium speed and medium altitude. The long-term policy is to revert to pure turbine jets for speeds of 500 m.p.h. and upwards at 50,000 ft and higher. Such progress awaits the advent of suitable air frames which may be flying wings or tailless craft with swept-back wings, embodying boundary layer control, and inevitably pressurization for the cabins.

Now, Mr. Standerwick, what is your view of aircraft of the future?

STANDERWICK:

You know, I'd be a fool to predict anything for the distant future, unless I was thoroughly sold on one thing—it is that young scientists and engineers to-day have the training and the daring to continue the search for the natural laws by which Divine Providence planned that the whole universe shall be guided. I am sure they'll advance this air age along the following lines: they'll expand the research facilities of our National Advisory Committee for aeronautics, for it is there that untiring efforts will be made to produce the design data for aircraft of the future. I mentioned those fifty thousand pound thrust engines. I believe that two of these would be ample power for an aeroplane with gross weight of around four hundred thousand pounds. In about twenty seconds such an aircraft would develop 110 m.p.h., with a take off of about half a mile or so. I'd expect the plane to have a wing span of between 350 and 400 ft. Wings very likely would be swept back, but I rather expect it would have the semblance of a tail. Outside on wings, there are probably two ramjets or athodyds to take over when speeds are increased to 600 m.p.h. where they should be fairly efficient. For high speed air transportation, I foresee a supersonic de luxe service of smaller planes, soaring up to 100 m.p.h. in the stratosphere to get out of this heavy atmosphere of ours. Even at thirty-five hundred m.p.h. the low friction would not cause these aircraft to burn up. "*If*," however, this is the flying condition we will meet up there one hundred miles above the earth, experiments here with rocket propulsion definitely indicate the future use of this type of power, as we go onward and upward in the conquest of time and space.

Atomic Power Prospects

I think we must also consider future developments in the atomic field. Here almost anything is possible, as recent military experience dramatically demonstrated. When we have harnessed atomic energy to the aircraft of the future, we hope to-day's ever-present factor of the fuel load will be replaced by a radically increased payload, thus revolutionizing once again the civilizing influence of the aeroplane, which first flew at Kittyhawk, North Carolina less than fifty years ago.

The aeroplane of to-day and tomorrow is attracting the finest brains and the greatest teamwork of the century among engineers and scientists. I sincerely hope this vital teamwork will be extended to the international field, for surely as you and I speak to each other across the broad Atlantic to-night, this age of speed will shrink the world to the point that nations too must work harmoniously together, and in doing so, learn each other's way of life in mutual understanding. Pooling scientific knowledge everywhere is one of the final stepping stones to the ultimate goal of one world living in peace.

THE THUNDERJET

ONE of the most promising of America's jet-powered military aircraft, several of which were mentioned by Mr. Standerwick in the two-way broadcast reported above, is the Republic P-84 Thunderjet which, during September, was officially timed by the F.A.I. at 611 m.p.h. over a 3-km course at Muroc Lake, California. The highest speed officially logged was 617.8 m.p.h., but, unofficially, the Thunderjet was claimed to have attained 619 m.p.h.

It has been revealed by the makers that the P-84 was originally conceived when the U.S. Army Air Forces asked them to redesign the P-47 Thunderbolt for testing the General Electric TG 180 axial-flow turbine jet. After several conferences the decision was taken to design an entirely new aircraft for this unit.

The Thunderjet, as the P-84 is now officially known, measures 36ft 5in in span and is 37ft 3in long. It is of exceptionally clean design and all radio antennae and armament items are internal. It is not generally known that the jet tail pipe has a controlled variable-exit nozzle, similar to that used on German axial-flow units.

The aerofoil sections selected for the wing and tail surfaces are similar to those adopted for the Rainbow.

AIRCRAFT PROPULSION

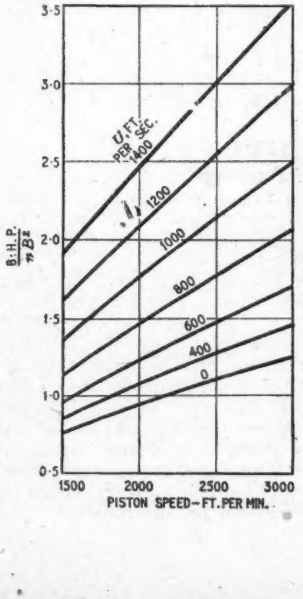
Net Thrust Horsepower as a Basis : Progress in Power/Weight Ratio and Thermal Efficiency : The Discussion : Ceramic Materials Suggested for Turbines

MAJOR F. M. GREEN is to be congratulated on delivering the main points of the paper that he and Mr. Wallington presented before a joint meeting of the R.Ae.S. and the Institution of Mechanical Engineers on November 29th, in an unusually lucid and concise form. He made it clear at the beginning, and subsequently in his answers to some of the points raised in the discussion, that the paper was prepared as a result of conversations regarding the development of power units specially for use in civil aircraft. He stated that investigation showed that for nearly all well-designed piston engines with a bore of 5 to 6in and compression ratio of 6:1 to 7:1, the volumetric efficiency was constant at very nearly 1; that friction losses were almost constant, as also were indicated thermal efficiencies; and finally that the air consumption per I.H.P. was very nearly constant, the figure being 10.6 h.p./lb air/min.

Calculations made by Mr. Wallington, based on the constant consumption of air per I.H.P., were used to give the weight of air per minute used by an engine at any altitude, the impeller tip speed and piston speed, and from these the b.h.p. and specific fuel consumption. Results were plotted, to avoid re-calculations, as a series of curves giving b.h.p. and fuel consumption in terms of cylinder bore, number of cylinders, piston speed and impeller tip speed at altitudes from sea level to 30,000ft. Examples of these curves for an altitude of 20,000ft are given in Figs. 1 and 2.

The conclusion reached was that although modern large piston engines have been developed primarily for military use, where fuel consumption is not all-important, they are quite suitable for civil work, and would not have differed appreciably if they had been produced specially for civil usage. The only modification likely to be required was a change of supercharger gear ratio.

Although b.h.p. was of interest, the special interest lay in the net thrust h.p. obtained by subtracting cooling and nacelle-form drag from airscrew and net exhaust thrust.



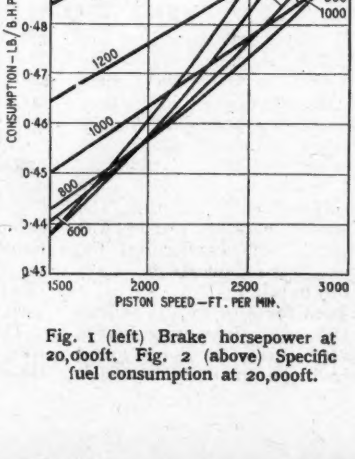
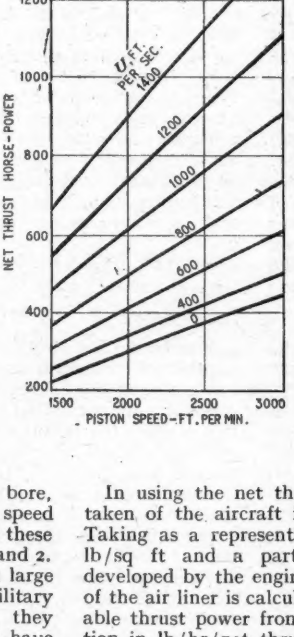


Fig. 1 (left) Brake horsepower at 20,000ft. Fig. 2 (above) Specific fuel consumption at 20,000ft.



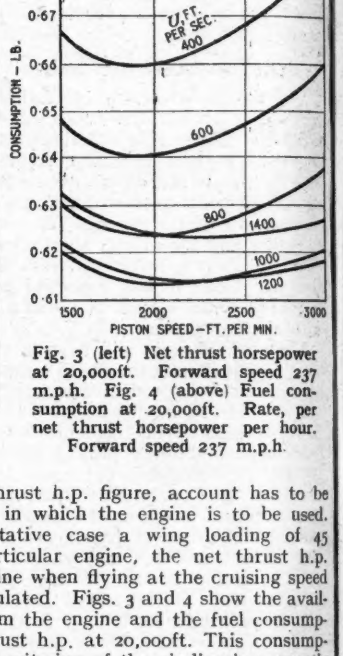


Fig. 3 (left) Net thrust horsepower at 20,000ft. Forward speed 237 m.p.h. Fig. 4 (above) Fuel consumption at 20,000ft. Rate, per net thrust horsepower per hour. Forward speed 237 m.p.h.

In using the net thrust h.p. figure, account has to be taken of the aircraft in which the engine is to be used. Taking as a representative case a wing loading of 45 lb/sq ft and a particular engine, the net thrust h.p. developed by the engine when flying at the cruising speed of the air liner is calculated. Figs. 3 and 4 show the available thrust power from the engine and the fuel consumption in lb/hr/net thrust h.p. at 20,000ft. This consumption figure is the real criterion of the air liner's economic performance from the point of view of petrol consumption.

Proportion of Exhaust Thrust

In their paper the authors stated that "Exhaust thrust of an air liner amounts to 5 to 10 per cent of the airscrew thrust. In a high-altitude fighter flying at 450 m.p.h. at 40,000 feet it may be as much as 30 per cent, the increase being partly attributable to the greater forward speed and partly to the higher degree of supercharge needed, which reduces the horsepower available for the airscrew.

"If one imagines a piston engine flying so high that all its power is used to drive the blower which is supercharging it, then obviously the whole of the thrust for propulsion must come from the momentum of the gases issuing from the exhaust pipe. One would then have in fact jet propulsion pure and simple. This brings us to the internal combustion turbine."

Mr. Wallington in his remarks following the discussion and to some extent in answer to criticisms said that there had been no intention of contrasting what the piston engine had done with what gas turbines might do. The piston engine was assumed to have had its day, and references in the paper were in the nature of an obituary.

The following portion of the paper reviewed the present state of turbine design. Major Green mentioned that the calculated theoretical figures for gas turbines, using the same basis as previously discussed, and checking against existing engines, showed good agreement. The lecturer continued:

"Thrust for flight, whether obtained by an air-

AIRCRAFT PROPULSION

screw or a jet, depends on the momentum per second of the slipstream. The kinetic energy of the slipstream is wasted energy, and the Froude efficiency of the airscrew or jet is $2Va/Va+Vj$, where Va is aircraft speed and Vj jet speed relative to the aircraft. The airscrew also wastes power because of the profile drag of its blades, and its overall efficiency is therefore lower than its Froude efficiency. The overall efficiency of a normal airscrew is usually about 82 per cent at top or cruising speed and 75 per cent when climbing, but at speeds greater than 450 m.p.h. the efficiency tends to drop.

"There is a limit to the efficiency of jet propulsion for subsonic aircraft, which proves to be a Froude efficiency of about 52 per cent at 36,000 feet and over. Choosing the ideal compression ratio for a gas temperature of 1,000 deg. C absolute, the minimum fuel consumption works out to be 0.62 lb per hour per thrust horsepower at 36,000 feet and over, which is better than is likely to be obtained with a reciprocating engine at that height.

"*Airscrews and Ducted Fans*.—The advantages of the simple jet propulsion system are very light weight of power plant and general simplicity. It has been seen that the Froude efficiency of a simple jet will not in practice exceed 60 per cent. It is obvious that an increase in the mass flow for a given power output will result in a decrease in slipstream velocity and a consequent gain in Froude efficiency; the lower the forward speed the greater will be the gain.

"The obvious way of increasing mass flow is to utilize an airscrew driven by a turbine that takes a fairly high percentage of energy from the jet. There will be a marked increase in the overall efficiency of propulsion, up to speeds of about 400 m.p.h.

"Neglecting take-off and climb, it is seen that at high speeds only small airscrews are needed, and at 400 m.p.h. and over the 'ducted fan' scheme has advantages. The usual mass flow through the fan is three times the gas flow through the turbine, so the total mass flow is increased four times; hence for the same thrust and speed the kinetic energy loss in the slipstream is reduced to a fourth.

"The disadvantages of the ducted fan are its greater weight and its greater diameter. There is, however, a potential decrease of consumption of about 10 per cent at 500 m.p.h., and this, for long-range commercial aircraft, might pay for the disadvantages.

"*Efficiency*.—There is an optimum compression ratio for minimum specific consumption, which depends on a number of variables. In general, a pure jet unit needs a lower compression ratio than a turbine airscrew unit, because with a jet the advantages of high thermal efficiency are offset by a high jet speed, which means a low Froude efficiency. The compression may be by a centrifugal blower or by a multi-stage axial-flow unit. The former permits lighter power units, but the compressors are about 5 per cent less efficient and limit the compression ratio to about 4 to 1 at ground level. The axial-flow unit can have any compression ratio desired, but higher ratios mean greater length.

"Above about 5 to 1 compression ratio, axial-flow units are difficult to start owing to stalling in some of the compression stages, and the result is that there is not enough power to accelerate the unit to a working speed. This can be avoided by using two or more blowers in series, each driven by its own turbine at an appropriate speed. It seems likely that a compression ratio of 12 to 1 at 36,000 feet will not be much exceeded.

"An alternative to high compression ratio—only worth considering for airscrew turbines—is the use of a heat exchanger to transfer heat from the exhaust to the compressed air on its way to the combustion chambers. If 90 per cent thermal ratio can be achieved, the optimum compression ratio becomes 3½ to 1, and the thermal efficiency of the cycle approaches 48 per cent. It is, however, doubtful whether the increase in weight and complication will make such a system worth while for aircraft."

Of power units with no moving parts, possible only at high forward speeds, the lecturers said: "This is jet propulsion at its simplest. The aircraft cannot be accelerated by this means below 300 m.p.h., and unless supersonic flight can be achieved the efficiency—even at 600 m.p.h.—will be low."

Turning next to the effect of temperature in gas turbines, it was stated that: "With existing materials and turbine design a maximum gas temperature of 1,150 deg. C absolute is practicable, i.e., 877 deg. C. At this temperature the life of the blades is limited by creep under stress, but at a lower temperature—about 1,000 deg. C abs.—a big increase in life can be expected, and it is usual only to use the higher temperature for take-off and emergencies. Temperatures of 1,000 and 1,200 deg. C abs. give only slightly different efficiencies, but the higher temperatures increase the output per lb of air per second and therefore make for lighter units.

"*Effect of Height on Power and Cruising Speed*.—Owing to the decrease in atmospheric temperature up to 36,000 feet the compression ratio of a blower at a given speed of rotation increases steadily and a blower designed for 5 to 1 ratio at sea-level will give nearly 7½ to 1 at 36,000 feet, this being the chief reason why the specific consumption decreases as the height increases.

"Owing to the increase in compression ratio with height the thrust of a jet unit falls off at a lower rate than the air density up to 36,000 feet, but afterwards (when the temperature is constant) directly as the air density. The exact rate below 36,000 feet depends on the particular design, but it is generally between $\sigma^{0.8}$ and $\sigma^{0.9}$, where σ denotes air density relative to sea-level.

"The top speed of a pure jet-aircraft is fairly constant up to near its ceiling, but there is generally a small increase between 30,000 and 36,000 feet. The economic speed, however, increases in proportion to $1/\sqrt{\sigma}$, and there is an improvement in fuel consumption per mile as height is increased, largely owing to the increase in Froude efficiency. With pure jet propulsion the cruising speed for the best range is 20 to 30 per cent above the speed of minimum drag.

"When the turbine is used to drive an airscrew the gain in overall efficiency with height is attributable not so much to the increased Froude efficiency as to the increased compression ratio resulting from the lower air temperature."

The Discussion

Dr. H. RICARDO, who opened the discussion, said that he admitted reluctantly that the piston engine was dead so far as military aircraft were concerned. He thought, however, that pistons would stay, and drew an interesting comparison between the recent introduction of the aircraft gas turbine and that of the marine turbine 50 years ago. The Royal Navy now employed turbines for most purposes, but this was not true of the Merchant Navy. Compounded engines were now also used in shipping. Commenting on the authors' figures for I.H.P./lb air/min and fuel-air ratio of 15:1, he said that these figures were given for the military engine of the four-cycle sparking-plug ignition type, but for civil use with lower supercharger ratio and slightly higher compression a figure of 11 h.p./lb air/min would be possible, and with fuel injection and sleeve valves there would be increased economy, and fuel-air ratios of 16:1 could be used. An improvement of almost 10 per cent (in the region of 0.38 and 0.39 lb/h.p./hr) on the authors' consumption figures of 0.42 was, therefore, possible with a piston speed of 2,000ft per minute. To replace lost take-off power, nitric oxide or water-methanol injection could be used.

Mr. H. CONSTANT agreed with the authors' conclusions and thought that even 0.37 lb/b.h.p./hr would be possible with suitable compression ratio. He had hoped for more detail of accepted gas turbine performances, and added in lighter vein that the authors had apparently arrived at the right answer by intuition having been guided by pessimistic piston engine figures, hypothetical turbo-jet figures, and no figures delivered for airscrew turbines.

Mr. DAVIS (Bristol Turbine Department) dealt with improvement of thermal efficiency and the Theseus heat exchanger. He showed (for the first time in public) a photograph of the heat exchanger unit and added that it could be removed from the airscrew-turbine when not needed. He proposed that an approach be made to the ceramic industry with a view to stimulating research on materials which might be suitable for turbine components.

Mr. CHESHIRE said that the authors suggested that jets must compete with piston engines on a fuel consumption basis, but other factors had to be considered. The installed weight of a turbo-jet was about one-third of that of the corresponding piston engine so more fuel could be carried. The drag was also reduced to perhaps two-thirds. He believed that gas turbines could operate reasonably at lower speeds and altitudes than those suggested, and named a compromised speed of 350 m.p.h. at which they could compare on a range and payload basis. He added that at the present time pure jet aircraft were capable of a 2,000 miles' range with a good payload. He doubted if the airscrew-turbine would be worth its weight and complication penalties, and questioned its noise and vibration characteristics. He was sure that the case for the pure

AIRCRAFT PROPULSION

jet units was better than it would appear from the statements of previous speakers.

Mr. JAMES HODGE also believed that the total weight of fuel and power units was the important figure, and quoted calculations to show that lower speeds could be economically employed for aircraft with pure jet units. He stressed that the low power-plant weight was specially important for short-range work, and said that although the fuel consumption might be high, the fuel cost was lower for turbo-jets than for piston engines; that there was no need for special fuel despite what the fuel companies said; and that high-speed operation would result in more aircraft-miles per hour and so reduced costs.

He believed that the absence of noise and vibration was most important to passenger comfort, but agreed with the lecturers that airscrew-turbines would also be used for a while Speaking for a second time, Mr. Hodge later mentioned noise and high-frequency vibration troubles on airscrew turbines, and in answer to another speaker he said that maintenance of turbo-jet power units in the R.A.F. had proved to be about half that for comparable piston engines.

Mr. R. SMELT, referring to drag coefficients, quoted 0.019 for the piston-engine fighter as compared with 0.015 for the turbo-jet fighter. He thought that Mr. Cheshire's reduced drag comparison figure of two-thirds should be nearer three-fourths. The turbo-jet installation was cleaner, but what was more important was that the absence of an airscrew gave a 20 per cent improvement in wing drag on a fighter, and this would be much more on a large civil aircraft. He mentioned transition points of 0.2 of the chord or even farther back, and possible drag coefficients of 0.007 or 0.005. He did not think that aerodynamic considerations had been taken into account sufficiently in the paper.

Air Comdre. BANKS, speaking in his characteristically decisive manner, agreed that no more changes would be seen in piston engines, but that more could have been done for economy by compounding. He thought the Americans might still do something because they were behind on gas turbines. At present it was thought in America that compounding might be a good thing, and turbo blowers with turbines in series were being considered. He illustrated the "blow-down" turbine arrangement for a large radial piston engine and added that the Americans believed that a consumption figure of 0.32 lb/b.h.p./hr was possible for a still-air range of 4,000 miles. With the use of 125/165 grade fuel and an 8.5:1 compression ratio we had already obtained a consumption figure of 0.365 lb/b.h.p./hr.

Air Comdre. Banks said that he was prepared to predict when gas-turbine powered civil aircraft would go into operation. Airscrew-turbines would be slower than pure jets in development, but the converse was true of the development of aircraft for these units. Prototypes of suitable passenger aircraft would be flying in four to five years, but piston engines would be in use for another ten years, and some for as much as fifteen.

Carrying passengers at 500 m.p.h. presented big difficulties, and in hot climates he had experienced bumps at 40,000ft. These problems were worse than the technical ones.

Mr. Rowe thought that the authors' approach using net thrust h.p. was a good one. He questioned, in practice, the low drag coefficients mentioned by previous speakers (on the ground of the sensitivity of suitable wing forms to minute surface irregularities), adding that aircraft would need a nightly wing polish. Meteorology became increasingly important for civil airlines operating at high speeds in that the aircraft must fly under their designed conditions or their economy was gone.

Open discussion followed the last speaker, and points raised concerned the great importance of comfort for passenger aircraft, with particular reference to noise and vibration; and the possibility of "reheating" in pure jets, giving 25 per cent static power increase but 75 per cent more fuel consumption, and resulting in effect in a ram jet behind the turbo jet.

Mr. WALLINGTON, commenting on the points raised in the preparation of the paper and later by speakers in the discussion, said that despite the problems, and in spite of any compounded engines which might be produced in America, he felt sure there would be no shortage of passengers for the jet air liners we should produce.

Cleveland Aero Show

Further Notes from "Kibitzer" on the American Exhibition

Continued from page 613.

IN the commercial fixed-wing aircraft section the Beech "Bonanza" and the North American "Navion" predominated. It is quite obvious that, for a time anyhow, these two machines will be in direct and almost undisputed competition for the four-seater light 'plane market. Consequently everybody wanted to have a look at them and form their own judgments. At present the "Navion" has the field, a few of them having reached the market, while the "Bonanza" is held up by engine trouble. This won't last; deliveries of the latter should start by the end of the year, and until that happens it is not fair to make comparisons. Having flown and liked the "Navion," the writer would prefer to wait for an opportunity to fly them both, one after the other, before making further comments. To look at, there isn't much to choose, but the butterfly tail on the Beech is undoubtedly attractive and has that mysterious "right" look that aerodynamically efficient things often have. Apart from these two, the private owner aircraft were represented by the usual collection of Stinsons, Aeroncas, Seabees, Ercoupes, and Cub-like aircraft.

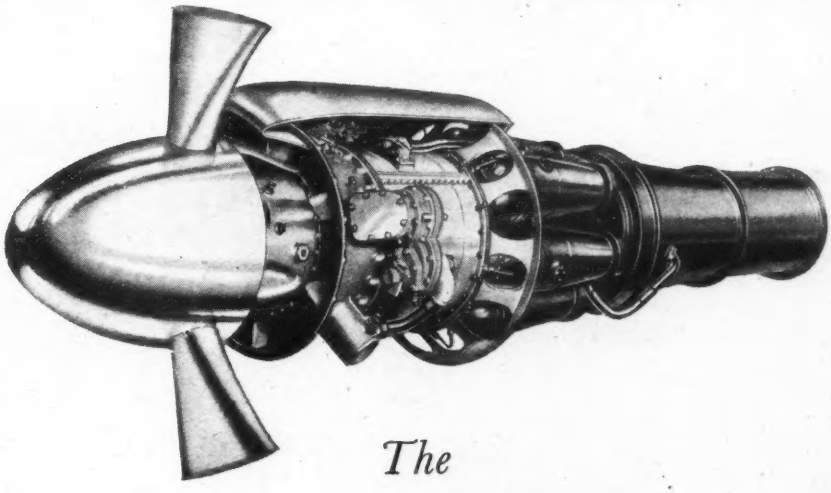
The Helicopter stands drew plenty of people and displayed types by Bell, Sikorsky and Firestone. The Bell Aircraft Corporation showed both their two- and four-seaters, and were busy giving demonstration flights to all and sundry. Their four-seater perpetuates the same attractive lines that marked the two-seater, and will presumably be put on the market in the not too distant future. The Sikorsky Aircraft Division of the United Aircraft Corporation had examples of their four-seater both on the stand and flying, and it is now in regular operation with Helicopter Air Transport, of Camden, New Jersey. They also had managed to get their two-seater which has all-metal blades to the show, but this is still in the development stage. The little Firestone two-seater follows along conventional lines, and looks pleasant enough, but apart from the machine shown, which has done a good deal of flying, it is not believed to be in production. Considering the amount of helicopter development going on over here now, representation by only three manufacturers was a poor showing.

It would take too much space to list in full the Army and Navy aircraft, but they went up in size from the little Bell single-seater interceptor fighter, with the Ranger engine built as a temporary measure in about 1942 (but never produced) to the P.80 and the B.29 long-range job. There was also an Army Fairchild Packet, a naval air transport C.54, and, dropping down in size again, a McDonnell "Phantom," a Grumman F7F, a Hellcat, a Bearcat, and the usual assortment of winged and radio-controlled bombs and target aircraft. The Fairchild Naval Trainer—reminiscent of a Harvard to look at, with a huge sliding, one-piece canopy over both seats—was in the Navy section. One of the most interesting things about this machine is that it embodies the U.S.-British standardized cockpit—a project over which many people worked many weary months. One look at this should convince them that their work was not in vain.

Towards the end of the show the Navy released details of the new Vought Naval jet fighter and a model appeared on the stand. This showed it to be a machine with a deep fuselage, the wing set far back, and the jet orifice at the bottom of the fuselage under the tail plane, with the pilot situated well forward of the wings. It is said to be powered with a new Westinghouse unit. This machine has made some satisfactory test flights at Muroc Lake, and promises to be quite fast. The Navy have now two jet fighters—the North American XFJ-1 and the Vought XF6U-1, both undergoing flight trials. [*Pictures in last week's issue.*—ED.]

A piece of information (unofficial and not necessarily true) gleaned from the Show was that the U.S.A.A.F. have by no means given up their attempts on the speed record. Furthermore, the use of a modernized form of Fido to raise the air temperature over the speed course when they try for the record during the winter months, has been suggested. On which warm note of optimism we stepped out into the Ohio night—temperature 28 deg—and thought how nice that would be for the fuel companies.

Eleven hundred and twenty horse-power in twenty-seven inches diameter!



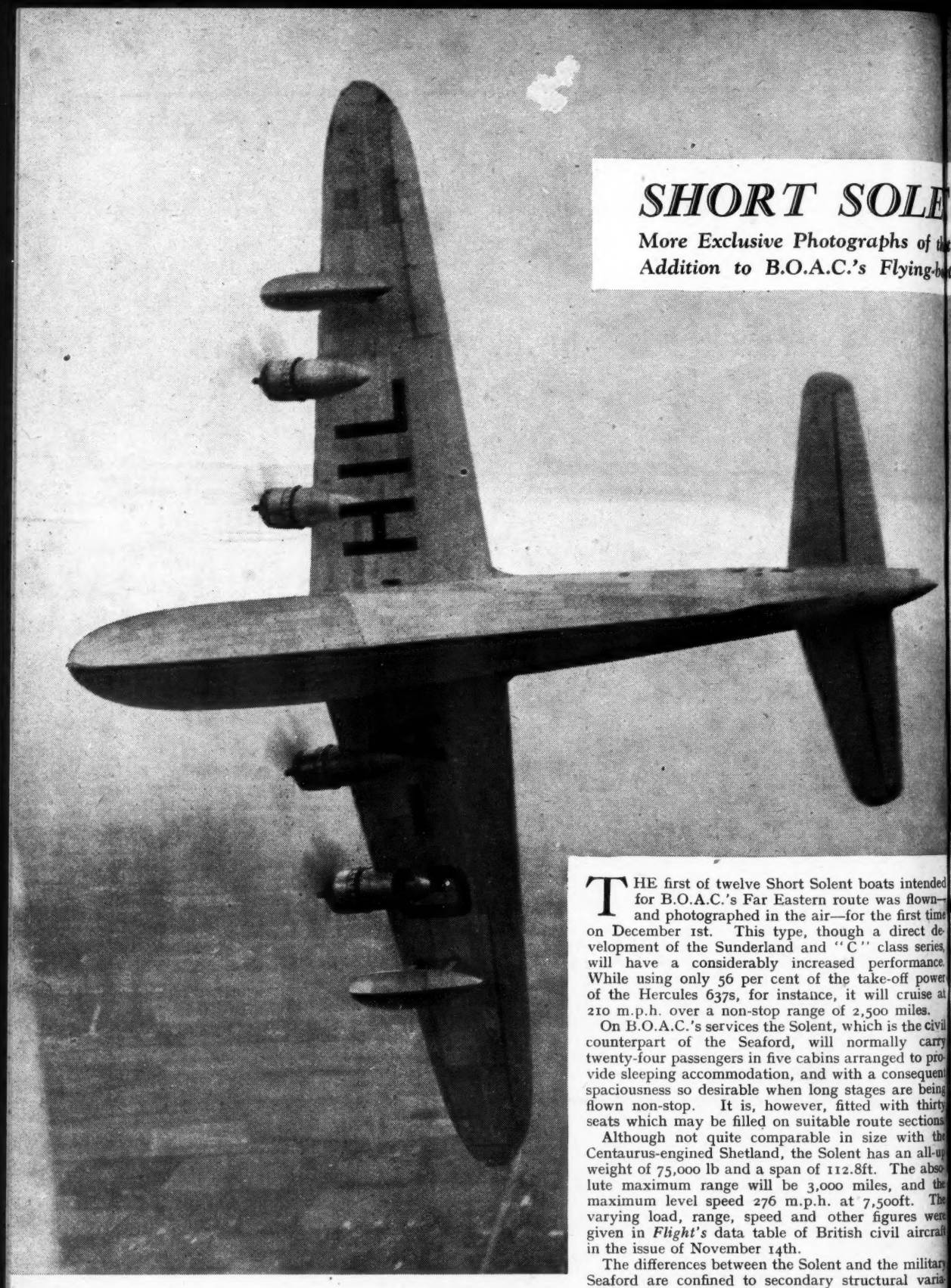
The

MAMBA

gas turbine propeller engine

ARMSTRONG SIDDELEY MOTORS LTD

Coventry



SHORT SOLE

More Exclusive Photographs of th Addition to B.O.A.C.'s Flying-bo

THE first of twelve Short Solent boats intended for B.O.A.C.'s Far Eastern route was flown—and photographed in the air—for the first time on December 1st. This type, though a direct development of the Sunderland and "C" class series, will have a considerably increased performance. While using only 56 per cent of the take-off power of the Hercules 637s, for instance, it will cruise at 210 m.p.h. over a non-stop range of 2,500 miles.

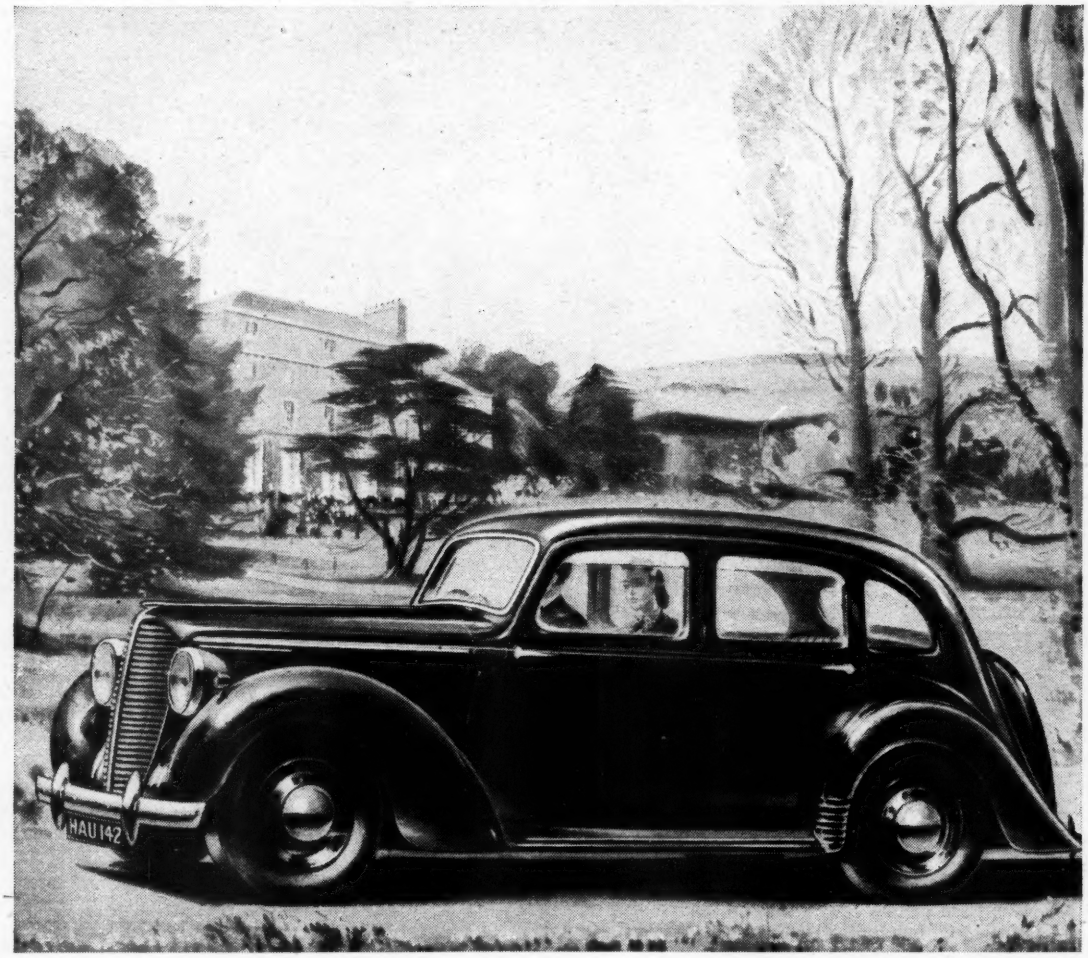
On B.O.A.C.'s services the Solent, which is the civil counterpart of the Seaford, will normally carry twenty-four passengers in five cabins arranged to provide sleeping accommodation, and with a consequent spaciousness so desirable when long stages are being flown non-stop. It is, however, fitted with thirty seats which may be filled on suitable route sections.

Although not quite comparable in size with the Centaurus-engined Shetland, the Solent has an all-up weight of 75,000 lb and a span of 112.8ft. The absolute maximum range will be 3,000 miles, and the maximum level speed 276 m.p.h. at 7,500ft. The varying load, range, speed and other figures were given in *Flight's* data table of British civil aircraft in the issue of November 14th.

The differences between the Solent and the military Seaford are confined to secondary structural variations which have, nevertheless, involved a complete rearrangement of the hull interior. Apart from the use of very much more power than in the case of the Hythe-class boats, both the Seaford and Solent have a considerably increased planing area to enable it to take off at the greater all-up weight. The new hull may be seen in the photographs on this page.

THE view above, and also that at the top right hand, shows to advantage the beautiful plan form and general shapeliness of the Solent. The basic layout is, of course, the same as that of the famous C class designed over 10 years ago. The Solent is presented before Flight's camera by Geoffrey Tyson.

In side elevation, the depth and roominess of the Solent's hull are emphasised, as is also the extreme cleanness of the tail unit.



For the family whose car is always in use . . .

The Hillman Minx is a car for the whole family to share . . . safe, easily handled in crowded streets . . . fast, roomy and comfortable on a long drive to the coast . . . quietly dignified for an evening in Town. A car that never runs up costs, that always keeps appointments . . . for the family whose car is always in use.

HILLMAN MINX

A PRODUCT OF THE ROOTES GROUP

CIVIL AVIATION NEWS

Australia Reviews Pilots' Licensing System : Hermes for B.E.A. : Charter Association Activities

AIR TRAFFIC DISCUSSIONS

APPRECIATING the present inadequacy of air traffic control over this country, and the remoteness of standardization of navigational aids, the Ministry of Civil Aviation have set themselves the task of bringing some order into air traffic. The attempt is being made assuming no assistance from any of the latest scientific developments; nor, in fact, from any but the normal communication facilities. A provisional scheme has been worked out and is understood to be under discussion with the Services and principal British users. New control areas will probably be established in which aircraft will be required to conform to certain procedures, and rules will be framed for the two conditions of flight, visual and instrument.

METEOROLOGICAL SERVICES

THE Meteorological Division of P.I.C.A.O. met last month in Montreal and studied ways and means of improving meteorological services for the benefit of aviation. Information is being collected to establish whether it would be possible to provide automatic weather stations in desert and such areas where it is impracticable to provide manned stations. This would make information available at all times, and would fill large gaps in the weather reporting services. The Division recognized that new demands would be made upon the meteorological services as soon as high-altitude flying along international air routes became common. Problems of providing accurate wind and weather information for aircraft flying at heights in the neighbourhood of 40,000 ft would require a different organization from that which reports weather conditions at the lower levels. To aid the collection of weather data for both ground and upper air levels, a new simplified code was prepared in order that information could more easily be transmitted from aircraft in flight. The Division stated that national meteorological services should develop their upper air analysis and forecasting techniques, and complete their portions of the network of radiosonde and radio wind stations

MORE ABOUT THE RAINBOW

FOLLOWING tests with the military prototype, some considerably higher performance figures have now been released for the civil Republic Rainbow. When carrying forty passengers, their baggage and 1,200 lb of freight, the average cruising speed at 30,000ft will range from 413 m.p.h. over a 3,000-mile trip to 423 m.p.h. over a 1,000-mile trip. At 40,000ft the best figure is 440 m.p.h. for 1,000 miles. A proportion of the extraordinarily high cruising speed promised is provided by the additional thrust from a special exhaust arrangement.

Obviously, this thrust will increase in value at high operating altitudes, and the performance estimates will depend very much on the success or otherwise of pressurization experiments. The Rainbow's estimated three-engined absolute ceiling, at full load, is 25,000ft, and is 5,000ft with only two engines in action. If everything works out according to plan, the Republic Rainbow, which is in the initial stages of production, is likely to make quite a difference to our ideas of airline operating speeds, though it is unlikely that any civil versions will be on the routes before 1948. Its all-up weight will be 114,200 lb.

ICING PROBLEMS

BRITISH European Airways have recently carried out trials with Viking aircraft under icing conditions. The trials revealed that when severe icing was experienced there was a tendency in some aircraft for instability to develop. As a result of this, the Corporation have announced that, pending further investigations, the Vikings will be temporarily withdrawn from service, and alternative arrangements will be made to operate the services with Dakotas and other aircraft. Twelve Vikings were in service on eight European routes, and six were being used for training purposes.

A FREIGHT AIRPORT FOR LONDON

LONDON Aero and Motor Services, by arrangement with the Air Ministry and the Ministry of Civil Aviation, have been granted a twenty-one years' lease of the airfield at Stansted Mountfitchet. The facilities will be limited at first to the use of the grass area and the runways, a large hangar and several buildings, including the flying control tower. The rest of the airfield will continue to be used by R.A.F. Maintenance Command as a stores depot, but more and more facilities will be made available to L.A.M.S. during the next two years, after which the R.A.F. will leave.

Standard Blind Approach services are already installed, but not yet in working order, and arrangements are being made with the Ministry of Civil Aviation for W/T and R/T com-

CIVIL AVIATION NEWS

munication and D/F systems to be provided. H.M. Customs have not yet arrived but will move in quite soon. Naturally, the airfield cannot function properly until these services are available, but it will be open from December 14th with its limited facilities. Control of flying is to be left entirely in the hands of the company. The airfield is to be thrown open to all passenger- and freight-carrying operators of all countries. The despatching and reception accommodation for passengers is to be kept strictly apart from the special freight handling sections. L.A.M.S. are making themselves responsible for the refuelling facilities, and it is hoped to have 100 and other octane fuels available.

The airfield, to be known as Stansted Airport, is about four miles from Bishop's Stortford, which is on the main London-Cambridge railway line, and motor transport will be provided for the carriage of freight and passengers to either the local station or to London, a distance of twenty-nine miles, if required. There is already a railway siding within the area of the airfield, and eventually it is hoped to be able to load and unload freight into and out of waiting railway trucks.

The runways are understood to be in excellent condition and are 2,000, 1,800 and 1,500 yards long. The surrounding country is, of course, very flat, and the approaches free from all obstructions. As more space is made available, other operators will be invited to open offices on the airfield.

London Aero and Motor Services are at the moment operating with four Halifaxes, but more are on order, and it is expected that quite soon the fleet will be increased to fifteen. There was, apparently, a little argument with the Ministry of Agriculture, who intended to plough up the grass area for cultivation, but the company proved to them that one aircraft could bring into the country more food than could be produced in the area concerned in one year.

CHARTER ASSOCIATION

THE membership of the British Air Charter Association has now reached a total of thirty—including B.E.A.C., who have joined the Association as "honorary members." By way of improving the shining hour, the Association has now adopted a crest with the motto: *Volamus ut Serviamus*, which, in general, means "We Fly to Serve." No mention is made of the ugly commercial factor which is so encouraging in a world of subsidy.

One of the more important matters at present under consideration by the Association is the preparation of standard forms of passenger and baggage checks, of air consignment notes and of air charter agreement. The recommended forms will shortly be submitted to a general meeting, and have been drawn up by a lawyer so that operators will be adequately protected.

Representatives of the Association recently met in Paris those of operators from France, Belgium, Holland and Norway, with the idea of creating an International Federation of National Charter Associations. The Federation was duly formed, and will have its secretariat in Paris, with the first president as Group Capt. W. E. Wynn, who is chairman of the B.A.C.A. The objects of the Federation are those of ensuring reasonable collaboration and the assistance of charter operators while flying abroad.

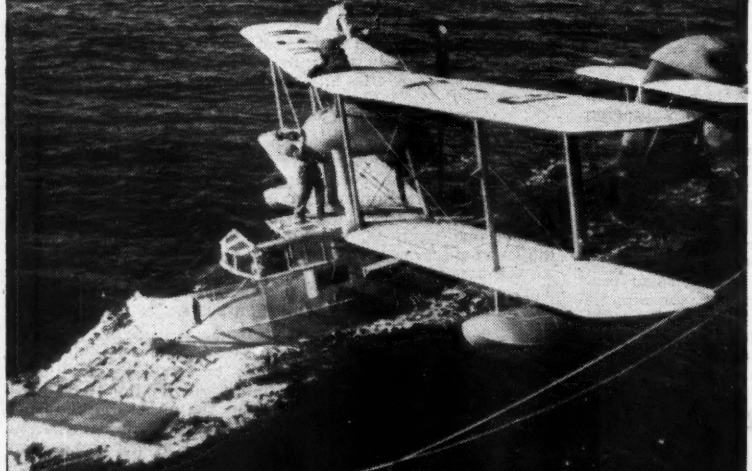
P.I.C.A.O. AND THE "Q" CODE

THE Communications Division of P.I.C.A.O. met during November and discussed, amongst other things, the use of the "Q" code in civil aviation. The United Kingdom and United States Armed Forces, who used this code during the war, will cease using it by March, 1947; it may then be adopted for all international air transport. The code was originated by the International Telecommunications Union in 1912, primarily for the use of merchant shipping. As the need for a similar code for aviation became apparent, certain sections were allocated for that specific use, those sections being supervised by I.C.A.N., whose authority has now been taken over by P.I.C.A.O. Many new groups have been added and the entire code is being reviewed. The Division will also discuss the relationship between P.I.C.A.O. and the Telecommunications Union, whose forthcoming conference is scheduled for next year. The Union is responsible for allocating all W/T wavelengths, and the present situation is badly in need of revision. More channels are necessary for communication purposes and the new navigational aids, and the Division is hoping that a comprehensive study of the requirements for air traffic will result in a further allocation of frequencies for the use of civil aircraft.

LARGER AIRCRAFT FOR B.E.A.

BRITISH EUROPEAN AIRWAYS are considering the use of a modified version of the Handley Page Hermes for some of the short-distance Continental services on which there is likely to be dense passenger traffic. An aircraft capable of carrying a large number of passengers, but with limited range, will be necessary, it is thought, in about two years' time. The advantages of operating such aircraft are obvious, but their operation cannot be an economic proposition unless the majority of the seats are at all times likely to be occupied.

The Corporation has also announced that twenty-five Mamba-engined Marathons have been ordered for use on British internal services, and for some services between provincial cities and the Continent. Delivery of these aircraft is expected to start some time towards the end of 1947. The Viceroy, or Vickers VC.2, which will eventually replace the Viking on the normal Continental routes operated by B.E.A., are (optimistically, we think) expected to be in service by the summer of 1947.



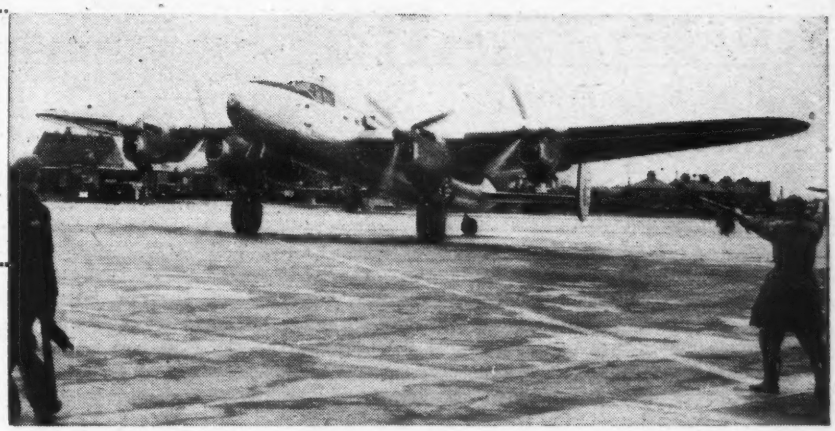
IN THE NET: At the end of a whaling reconnaisance the United Whalers' Walrus lands in the slick made by the factory ship. The ship tows a net on to which the Walrus taxies, and a hook attached to its keel catches in the mesh allowing the aircraft to be hauled into position from which it is lifted on to the deck.

B.O.A.C.'s SOLENTS

ON pages 650a and 650b are some pictures and a general description of the first of the twelve B.O.A.C. Short Solents to be flown. This may by now have been flown to Hythe for furnishing attention by the Corporation.

There will be three separate cabins on the lower deck, each with two pairs of facing double-chairs on one side of the gangway and a pair of facing chairs on the other side, thus making six in each cabin. There will be tables between each of the two pairs. The cabins will each be fitted with four bunks, making a total of twelve. To the rear of the third cabin is a promenade, in which, also, four bunks will be concealed. Two additional chairs may be fitted here if required.

Access to the upper deck will be from the promenade via a spiral staircase; at



EMPIRE HONOURS: The thousandth crossing of the Atlantic by Trans-Canada Airlines was made last week by this Lancastrian, photographed after landing at London Airport, Heathrow. The Merlin engines used on this route are T.24-4's specially modified to deal with severe icing conditions.

the top will be a lounge with an L-shaped settee and the entrance door to the adjoining pantry will be adapted as a bar counter. The aft cabin on the upper deck will be fitted with two sets of six chairs, with tables between, and will be used as a dining room for twelve. All the chairs are to be convertible to bunks—making eight of them.

The Solent, as delivered to B.O.A.C., will consist of the shell and main services only. Incidentally, the early Solents will have Hercules 20 engines, while later ones may have 130s. The complete crew will, in service, consist of a captain and first officer, a navigator, a radio operator, a flight engineer and two stewards.

FROM THE STATES

AMONG the various scraps of information—unofficial and, therefore, not necessarily true—that were gleaned by our representative at the recent Cleveland aircraft show were: That the Fairchild Packet freighter is not proving too satisfactory owing to loading difficulties; that the Curtiss concern are to build a four-engined transport; and that Boeings are building a large passenger flying-boat.

ANGLO-SWEDISH AIR SERVICES

AN agreement has been signed between the U.K. and Swedish Governments for the operation on a reciprocal basis of civil air services to, through and from their respective territories. The companies designated are B.E.A.C. and the Swedish companies A.B.A. and S.I.L.A.

The routes to be operated by the British Corporation are from London or Belfast and/or Glasgow and Edinburgh through Copenhagen or Oslo and/or Stavangar, if desired, to Gothenburg, Malmoe and/or Stockholm. Another route from the same British terminals through Copenhagen, if desired, and Gothenburg and/or Malmoe and Stockholm to Helsinki or beyond. And a third route from London through Amsterdam, Hamburg, Copenhagen and Malmoe to Stockholm.

The Swedish companies will operate from Stockholm and/or Gothenburg to London and through Oslo and/or Stavangar and/or Edinburgh or Glasgow to Dublin. Another route from Stockholm and/or Malmoe through Copenhagen, if desired, and/or Hamburg and Amsterdam to London. The third route is to be from Stockholm to New York and/or Chicago and Montreal and beyond through Copenhagen, Oslo, Prestwick and Gander.

LICENCE REVISION IN AUSTRALIA

THE Australian Civil Aviation Department has announced a new system for the licensing of civil pilots. The qualifications and experience required in the various categories have been designed to ensure the necessary degree of competence for the tasks to be performed, and to provide an orderly degree of progression for pilots from the student to the position of airline captain.

There are four categories. The first is for airline pilots' licences, which are divided into three classes, the first of which demands a minimum of 2,000 hours flying. The second class, requiring less experience, permits command only of those aircraft normally operated by one pilot, while the third class is for such as the first officer in those aircraft with two pilots, or the second officer in aircraft with three or more pilots. In the second category comes the ordinary commercial pilots' licence, which may be obtained after only 200 hours flying and some instrument flying experience, permitting the holder to fly for hire or reward on "air work," but not on regular public transport.

The third category introduces student-pilot licences, which will be necessary for anyone learning to fly after April, 1947. Eight hours' instruction must be completed before flying solo, and a private pilot's licence is not issued until a total of forty hours have been flown, of which not less than twenty-five have been solo. A written examination on air navigation regulations, traffic rules, meteorology and aircraft engines must be passed. This category is not only for beginners, but also for those pilots whose licences have lapsed.

Category four covers flying instructors with grades A1, A2, B1, B2 and C, according to experience and ability. It will be necessary for a pilot to hold one of these ratings before any instruction may be given in the air.

Two instrument flying ratings, limited and unlimited, have been introduced; no pilot without such a rating will be permitted to command an aircraft in blind-flying conditions.

This re-grading is particularly interesting since it follows very closely that planned for flying licences in this country—of which some general details were given in *Flight* of February 7th this year.

EMPIRE PACIFIC ROUTES

AUSTRALIA and New Zealand have signed bilateral air transport agreements with the United States, providing services between Auckland and San Francisco, and granting New Zealand the right to pick up and set down passengers at Honolulu and San Francisco. It is understood that negotiations are progressing with Canada to allow similar facilities at Vancouver. Until the British Commonwealth Pacific Airlines Corporation is ready to start operations, Australian National Airways will be responsible for these services, and Pan American World Airways has been named as the American company to operate to both Australia and New Zealand.

SCOTTISH ADVISORY COUNCIL

LORD NATHAN, the Minister of Civil Aviation, announced during his recent tour of Scotland the formation of the Scottish Advisory Council for the purposes of advising the three British Corporations on all aspects of Scotland's civil aviation. The Council will have direct access to the Minister.

The chairman of the Council is to be Sir Patrick Dollan, the Scottish Editor of the *Daily Herald*. The other members are Lord Provost Ure Primrose of Perth, who is well known in Central Scotland for his activities in civic and civil aviation affairs, Mr. J. Gibson Kerr, Viscount Arbuthnott, Mr. Daniel L. Stewart, Lord Provost Sir John Falconer, Lord Provost Sir Hector McNeill, Mr. Charles Murdoch, Treasurer of the Scottish T.U.C., Mr. David Robertson, member of the T.U.C. General Council, and Mr. Robert Taylor. Four other appointments are to be made.

Lord Nathan mentioned, during his speech at a reception in Edinburgh, his intention to create a Divisional headquarters in Scotland as one of the four which were to be established for the management of airfields in the United Kingdom. The controller of this Division would be Air Commodore J. G. Murray, who is at present the Director of Operational Services in the Ministry. Air Commodore Murray has been connected with civil aviation since 1929. The Minister also mentioned that it was the intention of the Ministry to develop airfields in Scotland to provide a relatively large network of air services in proportion to its population because of the difficulties of travel in many parts. Prestwick is to continue as an international airport.

CIVIL AVIATION NEWS

BREVITIES

The next annual general meeting of the International Air Transport Association will be held in Rio de Janeiro on October 14th, 1947.

* * *

A daily service has been started with two Lockheed Electras between six of the important towns in North Island, New Zealand. One aircraft will fly from Auckland around the east coast to Wellington and back to Auckland via New Plymouth, and the other in the opposite direction.

* * *

Panagra have started a daily service between New York and Santiago. DC-4s are used and the new extension will provide direct four-engined aircraft services from the principal cities in the United States to the capital of Chile. The company have created a new department for the sole purpose of promoting tours and organizing tourists' programmes in South America.

* * *

American Overseas Airlines have taken delivery of the first of fifty DC-6 aircraft. It is understood that thirty-six of these will be capable of carrying fifty-eight passengers by day, and the remaining fourteen will be provided with twenty-six berths for night journeys only.

* * *

The Standard Beam Approach equipment at Gardemoen Airport, Oslo, broke down last week. It is doubtful whether B.E.A. aircraft will be able to land at Oslo for another week or so; landings will be made, as usual, at Stavanger. The Corporation has recently flown some S.B.A. equipment to Oslo.

* * *

In addition to the various "free" civil airfields shown on the special map in *Flight* of November 28th, *Notice to Airmen* No. 199 gives, with two airfields which may be used in emergency or with prior permission, one other. This is Willingale, some 2½ miles N.E. of Chipping Ongar; it has three concrete runways, one being more than 2,000 yards long.

* * *

Following a simple moment of aural misinterpretation during a visit to Kenley, we happily proceeded to misinform both ourselves and readers about the identity of British Air Transport's chief pilot. He is Sqn. Ldr. G. R. Mack, M.B.E., and not Capt. R. H. McIntosh, D.F.C., A.F.C., who is now Airwork's chief pilot after 16,000 hours of flying.

* * *

Mr. P. E. Gordon Marshall, who has been with de Havillands since 1939 and was previously with the Straight Corporation, has been appointed a director of the D.H. associated company, Airspeed, Ltd. He will be based at the Christchurch factory and will mainly be concerned with the marketing of the AS-57 Ambassador.

* * *

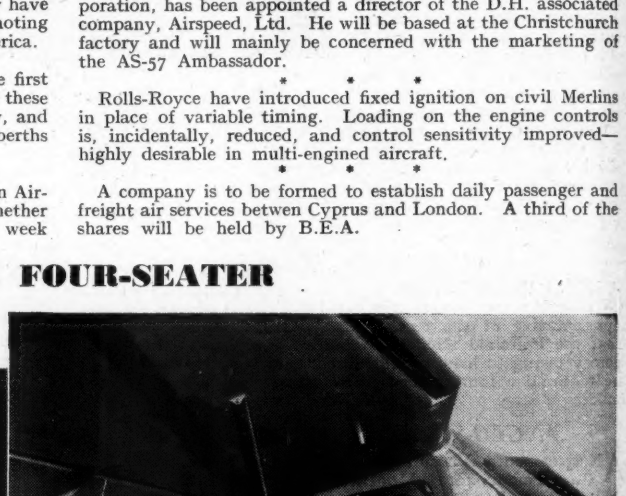
Rolls-Royce have introduced fixed ignition on civil Merlins in place of variable timing. Loading on the engine controls is, incidentally, reduced, and control sensitivity improved—highly desirable in multi-engined aircraft.

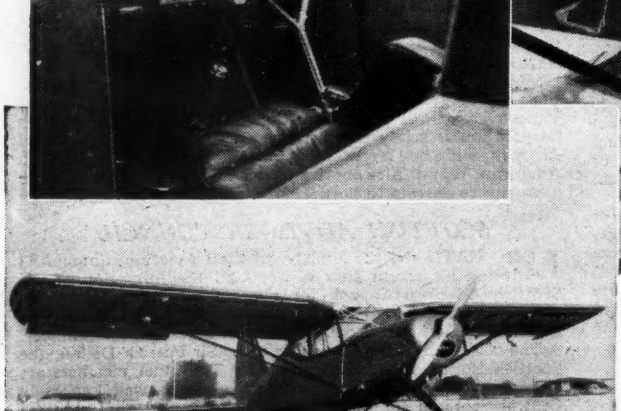
* * *

A company is to be formed to establish daily passenger and freight air services betwen Cyprus and London. A third of the shares will be held by B.E.A.

DANISH FOUR-SEATER

Larger Version of the Well-known KZ. III





Three views of the KZ VII which tell their own story. As with the III, fixed slots are fitted, with inter-connected flaps and ailerons. In the close-up, the chief designer, Mr. K. G. Zenthen, B.Sc., who made the first test flight, is on the extreme right. The VII's equipment includes an artificial horizon.

THERE is something very attractive about the better-safe-than-sorry formula as exemplified by the Danish KZ.III two-seater. This aircraft, some flying impressions of which were given in *Flight* of August 29th, is not particularly fast, but it is comfortable and without vice. At that time we explained that a four-seater version was on the way, and this is now in production at the works of the Skandinavisk Aero Industri A/S.

As a two-seater the III was not particularly useful for private charter work, so to meet the demand for an economical four-seater, the KZ.VII, or Lark, has been designed. Fundamentally, it is entirely similar to the III, with a slotted high wing of wooden construction and a fabric-covered welded steel fuselage. But it has a 125 h.p. Continental flat six, a radically modified undercarriage with a wider track and a steerable tailwheel which can be freed when steerability is not needed. In order to deal with the wider ranges of load distribution, the fore and aft trim is now corrected by an adjustable tailplane, with only a servo tab on the elevator. The two fuel tanks, with a capacity of twenty-four gallons, are in the wing roots.

The cabin is generally similar to that of the III, but an improved rear view is offered, and exhaust-gas heating is standard equipment. If the two rear seats are removed and the aircraft flown with the pilot only, 510 lb of freight can be carried.

The following are the more important data for the VII: Span, 31.5ft; length, 21.5ft; wing area, 140 sq ft; weight empty, 1,022 lb; all-up weight, 1,911 lb; wing loading, 13.5 lb/sq ft; max. speed (sea level), 124 m.p.h.; cruising speed, 109 m.p.h.; landing speed, 34 m.p.h.; rate of climb (sea level), 590 ft/min; service ceiling, 13,500ft; full-load unstick distance, 164 yds.

Power Installations

Part II of the Paper Given Before the Royal Aeronautical Society

By F. M. OWNER, M.Sc., F.R.Ae.S., M.S.A.E.

(*Continued from page 627.*)

Auxiliary Services

AFTER stating that the continuance of the Bristol policy (since 1935) of segregating the ancillary equipment and locating it on an auxiliary gearbox mounted away from the engine, would permit a wide variation of the services necessitated by the differences in aircraft types without needing corresponding alterations in power plant, Mr. Owner went on to discuss, under the heading of Additional Systems, air conditioning and pressurization. He said: "Refrigeration can be obtained by the intermediate cooling and expanding down to cabin pressure of air obtained from the main compressor system, and further compressed in a separate stage. The power obtained from the expansion of the air is utilized in a turbine to drive the separate blower necessary to complete compression. Such equipment could be easily removable from the aircraft as a complete sub-assembly. Humidification may be effected by injecting a quantity of water into the second stage of the main compressor.

"For tropical use dehumidification is achieved by utilizing the refrigerator system to cool the air below the dew point required in the cabin whence the requisite amount of water vapour is deposited, the air being reheated to a suitable temperature. . . . . When it is realized that to produce ground-level conditions in an aircraft at 20,000 feet, a compression ratio of 2:1 is required; at 30,000 ft 3:1; at 40,000 ft 5½:1; and at 50,000 ft 8½:1, it will be seen that the magnitude of the problem of pressurization of aircraft to these altitudes is indeed large.

"For compression ratios much in excess of 2:1 the conventional displacement compressor is unsatisfactory for aircraft installations . . . the centrifugal blower becomes the only satisfactory type. This is more evident when it is realized that a centrifugal blower operating at a normal output up to 40,000 ft has to accommodate intake volume flows varying by 400 per cent. To meet the wide variations of conditions of pressure and mass-flow imposed by these altitude requirements a variable gear system is necessitated.

"A more direct approach is, perhaps, the use of a multi-gear change-speed system utilizing the existing technique of supercharged two-speed clutches in suitable accommodation. It has been shown that a four-speed system should satisfy the demands of a 40,000-ft cruise altitude where a compression ratio of at least 4½:1 is required, and such a ratio can best be achieved for this purpose by means of a two-stage centrifugal blower."

General Trend of Development

Under the same power plant sub-headings the general trend of development was summarized by Mr. Owner as follows:

"*Piston Engine Fuel Economy*:—this will naturally lead to the use of fuels of high octane value in conjunction with high compression ratios.

"*Economy of Operation*:—It is essential that efforts be made towards the simplification of the engine as a whole and of its installations. Additionally, overhaul periods must be increased.

"*Specific Output*:—The developments under this heading are closely related to those concerned with fuel economy. There are, however, the additional factors of water-methanol injection and increased rotational speed.

"*Safety and Reliability*:—The most important development to be followed with regard to safety is the use of safety fuels and direct injection into the cylinders. The intermediate step of direct injection with normal fuels is already well under development."

Airscrew-Turbines

"In dealing with the airscrew-turbine engine it must be remembered that, unlike the piston engine, it operates at maximum efficiency under full-load conditions. Therefore, for maximum economy of operation its cruising speed will be 100 per cent of the maximum r.p.m. except in cases where at altitude it is limited by other factors, such as pressure cabins.

"*Fuel Economy*:—To obtain maximum fuel economy the operator will turn towards a cruising condition of full power at operational ceiling, since forward speed and low air temperature are essential factors. Apart from increasing the maximum turbine entry temperature, there are two basic means of improving the fuel economy of these engines, namely, increasing the compression and expansion ratio, and/or heat recuperation from the exhaust gases. Both these methods are under development, and in very general terms the conclusions to date are that the use of heat exchangers or generators results in an engine which is less heavily stressed but is considerably more bulky and of rather higher specific weight than the high-compression engine.

"Increasing compression ratio while retaining a heat exchanger is a development which can only be pursued to a limited extent, since the temperature difference between charged air and exhaust diminishes as compression ratio is raised. Where heat exchangers are concerned, it is considered probable that development will tend towards high thermal ratios in conjunction with low compression ratios.

"The importance of development to improve component efficiencies on the airscrew-turbine cannot be over-emphasized, particularly in the case of high-compression engines. As an example of the importance of this it may be mentioned that an improvement of 1 per cent on the compressor or compressor-turbine efficiency of the Theseus engine would result in an improvement of 3 per cent on the specific fuel consumption.

"The relative insensitivity of the gas turbine to fuels opens a new avenue of development, and research will be directed towards the production of fuels having a high calorific value per lb for use on long-range aircraft. Alternatively, there may be applications in cases where tank space is restricted for fuels having a high calorific value on a volume basis.

"*Economy in Operation*:— While it would not be true to say that turbine engines at the moment are any cheaper than reciprocating engines, it is nevertheless a fact that they are basically simpler, and will ultimately lend themselves to cheap production. The most serious obstacles in our way at the moment are the high cost of special materials which have to be used in the turbine, together with the high cost of the forging and machining of these same materials.

"So far as overhaul periods are concerned, it is not yet possible to give any figures based on experience. The Theseus, however, was designed with a limited target in mind of 1,000 hours before major overhaul. The principal factors affecting this period will be blade and disc creep, bearing life, and combustion chamber endurance. The turbine engine should show an appreciable economy over the piston engine so far as fuel costs are concerned.

"*Specific Output*:— There are two lines of development to be pursued in the case of airscrew-turbines, namely, increasing the maximum temperature at the turbine entry, and increasing the mass-flow through the engine by raising the rotational speed.

"*Safety and Reliability*:— It is considered that, as development proceeds, the turbine engine should prove safer, and more reliable than the reciprocating engine. So far as reliable operation of turbines is concerned, it is considered that the problems are considerably eased by the smooth torque of these engines and the almost complete absence of alternating stresses. The very high rotational speeds, however, demand extreme precautions where inspection of such items as turbine discs are concerned in order to eliminate the possibility of a catastrophic failure due to bursting."

Jet Turbine Engines

Dealing with turbo jets Mr. Owner said:— "The operating conditions and trend of development of the pure jet turbine are somewhat different from those of the airscrew-turbine. If the specific output of the jet engine is increased by working at higher temperatures, the energy available in the jet increases, but the jet velocity (and hence thrust) only increases as the square root of the available energy. Since the amount of fuel increases in direct proportion to the energy increase in the jet, the ratio of fuel used to thrust obtained (i.e., specific consumption) is increased. The fact that the jet discharge velocity is far in excess of any aircraft forward velocity which can be foreseen within the next ten

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years, also has a great influence on the operating conditions of the jet turbine. Any increase of thrust obtained by increasing the working temperature means a higher jet velocity and a lower Froude efficiency, increasing the specific consumption still further.

"In view of the interdependence of the factors affecting fuel economy and specific output of jet engines, these two subjects have been grouped together.

"*Fuel Economy and Specific Output*:— To improve the economy of a jet-propulsion unit, two main factors may be varied, i.e., peak temperature and compression ratio. An increase in peak temperature improves the efficiency of any practical thermodynamic cycle, but in the case of a jet propulsion engine, the overall propulsive efficiency must be considered in conjunction with the internal efficiency of the engine. Thus, as shown above, for compression ratios and aircraft velocities at present in use, an increase of peak temperature does in fact lower the overall efficiency of the engine due to the reduction of propulsive efficiency. It is interesting to note that the optimum temperatures are even now appreciably below the maximum permissible from the metallurgical point of view. However, it is necessary to use a reasonably high gas temperature to keep up the specific output of the engine, and, therefore, a compromise must always be made between these factors.

"Turning now to the effect of compression ratio, it can be shown that for a given aircraft condition of speed and height, an optimum specific fuel consumption occurs, which also varies with the gas temperature of the cycle. In a specific case of an aircraft travelling at 500 m.p.h. at an altitude of 40,000ft, the best fuel consumption is obtained at a compression ratio of 10 : 1 (ground level), and a gas temperature at entry to the turbine of about 750°C. These values will increase slightly with speed and altitude. In considering the use of high compression ratios, however, it must be borne in mind that the specific output tends to decrease, and the specific weight will increase before the optimum condition for fuel consumption is reached.

"From the foregoing it will be seen that it will be necessary to develop jet engines in relation to the performance of the aircraft classes for which they are intended. In the case of long-range aircraft of speeds below a Mach number of 1, it would appear that the jet engine should be designed with as high a compression ratio as can be reconciled with a reasonable power/weight ratio. In the case of very high-speed short-range aircraft of the interceptor fighter type, lower compression ratios and higher peak temperatures will be used. The ultimate trend in this field will be towards the propulsive duct.

Detail Problems with Turbine Engines

"*Turbine Materials*:—The demand for higher temperatures and operating speeds will call for improved material from the metallurgist, and research work will be necessary for the production of suitable ceramic materials for blades. As an intermediate step hollow turbine nozzle blades and rotor blades with air or liquid cooling will be developed. The use of castings in high-temperature materials for turbine casings necessitates the development of a new foundry technique to obtain the necessary accuracy and thin sections.

"*Compressors*:—The design of axial compressors will be directed towards the use of higher Mach numbers without loss of efficiency with a view to reducing the overall dimensions and increasing the pressure rise per stage of this component. Experience is not yet available to justify any assessment as to the relative merits of alternative compressor blade materials, but it is evident that it will be necessary to ensure that the blades will operate satisfactorily under desert conditions. This factor combined with the higher temperatures likely to be encountered in the later stages of the compressor may lead to the abandonment of light alloys for compressor blades, at any rate in some of the stages. An alternative to changing material to avoid sand erosion will be the development of a suitable surface-treatment.

"*Combustion and Fuel Injection*:—The combustion and fuel injection systems of the gas turbine engine as we know them at present will require much development to increase their reliability, reduce pressure-drop, improve combustion at very low engine speeds, and ensure satisfactory lighting characteristics under conditions of altitude and high forward speeds. Furthermore, it is necessary that the control system be developed towards the ideal of a single lever. Speed control, particularly in the case of airscrew engines, must be developed to give a very high degree of accuracy.

"*De-icing*:—De-icing problems have been briefly discussed in a previous section of this paper dealing with installations, but the necessity for considering means for de-icing air intakes and axial compressor blades, when laying down the basic design of an engine, cannot be too strongly emphasized, and this is not a problem that can be left to the installation engineer to deal with as an "afterthought." Here again no experience is yet available, but considerable thought has been given to this subject and various proposals have been made, such as the use of alternative air intakes to allow hot air to be taken from around the jet pipe, and the actual tapping-off of some of the exhaust gas and by-passing it to the compressor entry.

"*Reduction Gears*:—The design and development of reduction gears presents certain new problems. The first is to produce a light and compact gear with the high reduction ratio required. This usually leads to the adoption of an epicyclic gear with its associated problems of planet-cage design and high centrifugal loadings (unless the form of epicyclic gear is carefully chosen). In view of the absence of large torque fluctuations, it should be possible to make the reduction gear generally lighter than that for an equivalent piston engine. There are, however, indications that troubles may be experienced due to high-frequency vibrations, although these have not been common to all types of airscrew-turbine.

"*Bearings*:—The development problems associated with turbine bearings are considerable by the very nature of the conditions under which they are called upon to operate. These conditions are very high rotational speeds, high end-thrusts and high temperatures. The direction in which development will take place will be towards improved heat insulation and cooling of the bearings and mountings, improved lubricants, alternative materials for the bearings having higher tempering temperatures and better standards of manufacture and inspection. The latter items are of particular importance, not only in increasing bearing life but in ensuring consistency of performance.

"*Seals*:—The trend towards higher compression ratios will place increasing importance upon the design of air and oil sealing. Development of these items becomes an essential factor to reduce oil consumption and bearing end-loadings by pressure balancing. It is vital to provide adequate oil sealing at the entry to the compressor to avoid fouling of the blades.

"*Lubricants*:—The gas turbine generally, and the jet type in particular, have given rise to a demand for lubricants having a very low pour point. It has long been the designer's (perhaps pious) hope that a lubricant will be found which will retain its viscosity at high temperatures, and will enable him to use what are in effect grease-packed bearings for his turbine wheels. Silicones have been suggested for this purpose, but to date have been disappointing.

"*Airscrew Control*:—Airscrew controls may have to be divided into two classes: (a) those for engines having independent power turbines, (b) for engines having the airscrew driven directly from the compressor shaft.

"In the first case the control is relatively simple and may if desired be done by a normal type of constant-speed unit. Whether this or a speed-ratio type of control between the compressor and airscrew turbine is used, provision will be made to vary the airscrew speed in relation to the compressor over the widest range permissible on grounds of turbine efficiency. This will enable the airscrew to operate at improved efficiencies for take-off and cruising and will reduce noise problems. Experience to date on the Theseus engine indicates that the rate of acceleration with the independent power turbine is so great that increased rates of pitch change will become necessary.

"Where the airscrew is driven directly from the compressor shaft the problem of control becomes much more difficult since the airscrew speed cannot be varied in relation to the compressor, and airscrew and fuel controls cannot be divorced from one another. A further difficulty arises under starting conditions, where in order to decrease the starting torque it may be necessary to put the airscrew into zero pitch.

Concluding Observations on Engineering Problems

"*Research*:—Pride of place amongst requirements must be occupied by the study of aerodynamics, which lies at the root of progress in both turbine and aircraft. High-speed wind tunnels and airflow test rigs are needed, and these can conveniently be combined with large-scale apparatus which is an imperative necessity for carrying out research work on compressors and turbines.

"Research work on combustion will also proceed in parallel, together with its associated subject of fuel investigation.

"*Design*:—Little can be added at this stage to the review already given, but it should be commented that a great deal of new design will have to be initiated. The provision of

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adequate air and oil sealing devices to cater for speeds of the order of 10,000 r.p.m. and pressures of the order of 100 lb/sq in or more at temperatures which may be in excess of 200° C is a case in point.

"*Development*:—In development, an enormous amount of work has to be done on the gas turbine engine before its background can be in any way comparable with the piston aircraft engine on which 40 years' unremitting effort has been lavished. The jet engine is piling up a considerable background of very satisfactory operation, but none of this is, as yet, in commercial service, and the airscrew turbine has very little development background indeed.

"*Production*:—The chief problem confronting the production engineer during the coming period will be the maintenance of production on a reasonably economic basis, and at the same time preserving the flexibility of organization and tooling which will be necessary to cope with the repeated changes caused by the enormous strides made in power-plant technique. The specialization of power plants for particular applications will add to the difficulties of the production engineer, in this case, by reducing the size of his batches, and a halt will have to be called somewhere in the process of 'tailoring' the power plant to the individual aircraft, if high costs are not to result.

"The development of new techniques as, for example, precision casting, has proved of the utmost value in turbine design, and with the possible advent of such items as ceramic blades will have to be extended into even more unusual fields. This factor, together with the introduction of high-temperature materials as regards casting and machining will offset, to some extent, the attractive simplicity of turbine power plants from the production engineer's aspect."

"Turbine blades are, however, likely to remain the most outstanding and expensive items to manufacture, and these are required in quantities which almost reach the scale of mass-production, so that special techniques are justifiable.

"Broadly speaking, the gas turbine should, in due course, represent as acceptable an advance to the production engineer as it does to his design and development colleagues."

Oxford University Air Squadron Dines

Twenty-first Anniversary Celebrated at First Post-war Dinner

ON Friday, December 6th, the O.U.A.S. held its first post-war annual dinner at the Randolph Hotel, Oxford. Like most other things when compared with their pre-war counterpart, the occasion had an air of austerity. The atmosphere of a public dining room with waitresses "shunting" the port could not be expected to match that of the Squadron's own premises in Manor Road.

There was, however, no lack of distinguished Service and University guests for the top table, and it was gratifying to find a number of past C.I.s of the Squadron and old members of the staff, both here and elsewhere among the guests. In particular, the guest of honour, Air Marshal Sir Roderic Hill, K.C.B., M.C., A.F.C., A.D.C., and Air Chief Marshal Sir Keith R. Park, G.C.B., K.B.E., M.C., D.F.C., must be mentioned as past C.I.s. The Chief Instructors from Cambridge and London University Air Squadrons, Wing Cdr. Viscount Acheson and Wing Cdr. D. W. Reid respectively, were also guests.

From references in speeches to aircraft being "dropped six feet" and gremlins in Tigers, which showed no respect for rank, a guest might have been led to believe that a member of the Squadron staff—perhaps even a very senior member—had recently made a somewhat abrupt arrival by air.

Oxford's present Chief Instructor, Wing Cdr. J. R. A. Embling, D.S.O., proposing the guests, mentioned that in effect the dinner marked the Squadron's 21st anniversary. He also referred to the Squadron's excellent wartime record, including no fewer than two V.C.s and 26 D.S.O.s, and decorations for one in four of the 500 pre-war members.

Reply for the Guests

Air Marshal Sir Roderic Hill's speech in reply to the toast was much appreciated by everyone. He mentioned the requirements of the Service to-day, the University's past and future contribution to the R.A.F., and he blended these more serious thoughts with touches of humour. Of the R.A.F. he remarked that for himself "familiarity bred a growing wonder," machines had "arms in their wings, eyes in their noses, bombs in their bellies . . ." The R.A.F. was a precocious child which had now gone so far as to carry its elder brother. Sir Roderic said that, like teeth, they were a nuisance (referring to Field Marshal Smuts' "peace with teeth"), but one was inarticulate without them.

Proposing the Squadron, Col. C. H. Wilkinson, O.B.E., M.C., M.A., of Worcester College, made a classic (and classical) speech. He managed to review much of the Squadron history, referring with a happy intimacy to its early C.I.s and poking fun where deserved. He said that primitive people who had bad news to announce used to pay a clever and learned man to announce it for them, but when it was good news they used any poor fool to announce it and sacrificed him afterwards. In good times the O.U.A.S. asked the Principal of Brasenose, Dr. W. T. Stallybrass, to propose the Squadron; this year he had been asked. He concluded by likening the Squadron to an earthly Valhalla for flying men and said that the Squadron at present differed in degree but not in kind.

Mr. G. C. R. Morris, of the O.U.A.S. and Balliol College, replied and mentioned the gremlins—no respecters of rank—in the Squadron's Tigers. He also put in a plea for more and better aircraft.

NAMING CIVIL AIRCRAFT

WE are indebted to several correspondents who have written to amplify and rectify some of Mr. Gordon White's statements in the article bearing the above title in *Flight* of November 28th. Information is as follows:

Imperial Airways operated two D.H.34s, G-EBBW and G-EBCX, but not G-EBBS.

For the sake of history the Argosy G-EBOZ was at one time named *City of Arundel*.

The Calcuttas G-EBVH and G-AATZ were at one time *City of Athens* and *City of Salonica* respectively.

The use of letters to denote class was not introduced until 1936, when the C-class Empire flying-boats appeared.

The following D.H.86s should be included: G-ADFF *Dione;* G-ADUE *Dardanus;* G-ADUF *Dido;* G-ADUG *Danae;* G-ADUH *Dryad;* G-ADUI *Denebola;* and G-AEAP *Dementer;* also the following Empire flying-boats: G-AEUG (VH-ABC) *Coogee;* G-AEUH (VH-ABD) *Corio;* G-AEUI (VH-ABE) *Coorong;* G-AFBJ (VH-ABA) *Carpentaria;* G-AFBK (VH-ABB) *Coolangatta;* G-AFBL (VH-ABF) *Cooee. Clare* should also have been included among the S.30 boats.

G-AEVW and G-AEVV were Air Ministry long-range aircraft and not in the Imperial Airways fleet.

Four of the E class aircraft were allocated Indian names and registrations. Some were painted on, but I do not think they were ever operated with them. They were: G-ADSS (VT-AJE) *Ellora*); G-ADSU (VT-AJF *Everest*); G-ADTA (VT-AJG *Ernakulam;* and G-ADTC (VT-AJH *Etah*).

Golden Fleece was originally *Grenadier,* and *Golden Horn* was *Grenville.*

To complete the Imperial Airways list the three Supermarine Sea Eagles should have been given. They were G-EBFK, G-EBGR and G-EBGS. At the same time as the King class were operated, the Lockheed 14, Hudsons and Lodestars were also carrying names.

Jersey and Guernsey Airways only owned four unnamed aircraft prior to the war. They were Rapide, G-ADBW, D.H. 86s, G-ADVK and G-AENR and Flamingo G-AFUE.

The Dragons were: (left-hand list): G-ACMC, G-ACMJ, G-ACMO and G-ACMP, and (right-hand list) G-ACNH, G-ACNI, G-ACNJ and G-ACNO.

St. Ouens Bay II was G-ADBV.

The D.H.86s were G-ACYF, G-ACYG, G-ACZN, G-ACZP and G-ACZR. Another D.H.86 was G-ACZO *Ouaine Bay.*

The Windhover was G-ABJP and the *Cloud of Iona* G-ABXW.

The following typographical errors occurred: Spellings, *Dorado, Britomart, Portelet Bay* and *Grouville Bay.* Short *Mercury* S20 (upper) and *Maia* S21 (lower) component. Empire flying-boats were C23s, not S23s, and D.H.868 should, of course, have read D.H.86B. In addition, certain registration numbers were inaccurate.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

"LET BRITONS SEE"

Public's Pride in Their Aircraft

MANY of your readers must have been glad to see Charles Gardner's letter, "Let Britons See" (*Flight*, November 28th). I am ex-R.A.F. myself, but since being demobbed I have been agreeably surprised at the enthusiastic interest and pride which Mr. and Mrs. John Smith (and little Willie) take in British aircraft. My copy of *Flight* is well thumbed after it has done the round of the factory in which I work. We cannot buy, but we *should* welcome the opportunity of seeing. We would get up to London somehow, but naturally we should feel greatly elated if the show were put on in a more central position—Birmingham, or even Manchester.

Stoke-on-Trent. P. HUBBALL.

THE PARIS SHOW

Let British Workers See It

THE Paris Show has no doubt given executives of the aeronautical industries a most interesting and revealing study of Europe's capabilities in the face of embarrassing restrictions and shortages.

Our own aircraft workers are under a similar, if lighter, handicap. They are urged that upon their skill and workmanship lies the result of the present competitive fight for the lead in the air.

It would be stimulating for them to be able to see for themselves what they are competing against; it would encourage otherwise unrewarded endeavour.

Would it not have been possible for a representative few from the factories of firms exhibiting in Paris to be taken to "see for themselves" for seeing *is* believing? "474."

MIXED JET LAYOUT

Tudor I as High-Altitude Test Bed

IT is surprising that one aspect of aeronautical progression seems to have been overlooked by writers in the turbo- and prop-jet field.

It is generally accepted that to operate commercial aircraft economically it is necessary to fly at great altitudes and high speeds. With jets (unlike piston engines) it is possible to fly at moderately high speeds in the sub or lower stratosphere without great difficulty. Nevertheless, due to speed limitations of the working parts, it is necessary to reduce the output of a turbo-jet engine in order not to overstress the mechanism; this keeps the aircraft to approximately the same speed throughout a large percentage of its operating altitude range. All the foregoing is, of course, familiar to all acquainted with this subject.

The aspect I wish to refer to is a suggested layout for mixed jet units, utilizing compressorless units with more conventional types of jet engine. The compressorless units could be built on modified Leduc principles.

A suggested complete layout could be, for instance, a Tudor I aircraft, on which a great deal of pressurization research work has been carried out; this type of machine should be an ideal test-bed for high altitude work. The inboard engines could be conventional jet engines of well-tried types, such as Derwents or Nenes. The outboard pair of power units to be of the ducted compressorless type. The principle of the layout is to utilize the fuel not required by the inboard units at altitude and use it in the outboard units. These could be fitted with a permanently heated electrical igniter, maintained by the inner power unit's services.

The sequence of such a layout would be, theoretically, as follows: The aircraft would take-off with the inner units only in operation. As the altitude increases the outer units would begin to operate; the heater element would be in operation originally so no difficulty would be experienced in starting combustion. The thrust output for any specified altitude would be increased with the same fuel consumption as at sea-level. Although the fuel-thrust ratio would be considerably lower at altitude than at sea-level, owing to inefficiency of the compressorless units, it does not seem unreasonable to suppose that an improved thrust-drag ratio should be obtained.

With the conventional type of jet-unit the speed remains practically unchanged with altitude but the fuel consumption is reduced, whereas with the suggested layout the fuel consumption would remain unchanged but the speed would be increased. This fact, together with the higher permissible operating height of the suggested aircraft, would greatly offset the consumption disadvantage, even if not completely balancing it.

The foregoing paragraph could quite easily start a controvery; would it be best to travel fast for a high consumption or slowly for a lower consumption? All this may drag up a whole book of statistics, and as that is ground previously covered at great length, it is hardly necessary to mention them here.

In the event of the failure of one of the inner jet units, the outer ones may be able to hold the aircraft in the air, or at least lengthen the glide until a suitable landing ground could be reached.

One obvious objection to modifying the particular machine mentioned, would be the difficulty of undercarriage retraction, this could probably be overcome by modification of the wing centre section to receive an inward retracting undercarriage; this should not be too difficult as the shorter shock-leg due to fitting jet units would not require a great deal of room.

I hope these comments will be given the thought I believe them to deserve. There is no suggestion that any specific aircraft must necessarily be used, but the Tudor I seems to be the most suitable existing machine for the purpose.

R. P. DENTON.

A CHANCE TO FLY

Plea to Re-form the C.A.G.

MAY I make a humble plea for the re-establishment of the Civil Air Guard? I want to fly more than anything else in the world, and at the moment I cannot see any way of fulfilling my ambition. I cannot join the R.A.F. because I am a girl, and I cannot join a flying club because the cost is too great for my purse.

There must be a good many people in the same position as myself, and if only the Civil Air Guard could be re-formed, we would have a reasonable chance of learning to fly.

JANET FERGUSON.

FOR THE BOOKSHELF

We Dropped the A-Bomb. By Merle Miller and Abe Spitzer. Thomas Y. Cromwell Co., New York. Two dollars net.

AN American journalist and a B-29 radio operator have collaborated in this account of happenings associated with Nagasaki and Hiroshima incidents. They set out to throw a spotlight on the emotions of aircrew concerned. The light seems to have been borrowed from a Hollywood studio.

Spitfire. By John W. R. Taylor and M. F. Allward. The Harborough Publishing Company, Ltd. 15s net.

THE history of the Spitfire has become a study in itself. So many variants of this historic aircraft have been developed to meet new and changing operational requirements that to all but a fanatical few its story remains obscure. This new work outlines in an able manner the evolution of the Spitfire, records its great victories and presents scores of fine photographs. It is a thorough and attractive record.

The Royal Air Force Athletic and Games Handbook; R.A.F. Sports Board; 5s.

VERY complete information on a variety of sports and games, most of which are controlled in the R.A.F. by their own associations, is contained in the 600 or so pages of this handbook. These range from athletics to yachting, and the amount of space allotted to each and the nature of the information given vary according to the conditions and organization of the individual game as they affect the Service participant.

In every case, however, the rules of the game (and its relevant association, if any) are set forth with commendable clarity. Even baseball is included, though its mysteries are covered (with some very necessary diagrams and sketches) in a mere seven pages as compared with 15 pages devoted to cricket, and considerably more to boxing, swimming, football, fencing and rugby. There is also a very useful section on the care and maintenance of sports grounds, pitches, cinder tracks, etc., and of equipment and sports kit, while a thoughtful homily on refereeing and umpiring rightly stresses tact as one of the essentials in these important duties.

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"Flight" photograph.

DIMINUTIVE GIANTS: Avro Lincoln heavy bombers (span 120 ft., normal weight 82,000 lb.) are dwarfed by the drifting magnificence of a cloudscape. They are flying near their base at Lindholm.

Royal Air Force and Naval Aviation News and Announcements

K.G. for Viscount Portal

VISCOUNT PORTAL OF HUNGERFORD, former Chief of Air Staff, was appointed Knight of the Garter in an Honours Supplement to the *London Gazette* on December 3rd. Viscount Portal is 53.

C.A.S. in Tokyo

MARSHAL OF THE R.A.F. LORD TEDDER arrived in Tokyo on November 30th for a two-day visit. He was the guest of General MacArthur, Supreme Allied Commander in Japan.

Cumulo-Nimbus Study

AIR VICE-MARSHAL BASIL EMBRY (D.S.O. and three Bars), Director-General of Training at Air Ministry, has been appointed to head a committee to investigate the dangers of flight in cumulo-nimbus clouds.

Netherlands Decoration for Group Capt.

AT The Hague, on December 2nd, Prince Bernhard of the Netherlands decorated Group Capt. G. F. Wood, R.A.F., with the Commander's Cross of the Order of Orange Nassau. Prince Bernhard said to Group Capt. Wood and other officers: "We have no other means of expressing our thanks to you for everything you have done than to give you a decoration. Be convinced that you have won a warm spot in our hearts."

R.A.A.F. Thanks Britain

ON behalf of members of the Royal Australian Air Force who served in the European theatre of war, Air Comdre. U. E. Ewart wishes to thank the people of Britain for their hospitality.

Air Cadets in Germany

TWO Dakotas carrying twenty-two A.T.C. cadets took off from R.A.F. Station, Abingdon, Berks, on December 2nd for a five-day tour of British Air Forces of Occupation in Germany.

It was planned to show the cadets some results of R.A.F. bombing at the Bielefeld Viaduct (against which the 22,000 lb bomb was first used), the Mohne Dam and Hanover.

The Aboukir Boat Club

WITH the closing down of R.A.F. Station Aboukir the 20 years of flourishing existence of the Aboukir Boat Club have been brought to an end but the boats are to be transferred to the Canal area where it is hoped a new club will be formed as soon as possible.

Formed under the Presidency of Group Capt., now Air Marshal, Sir Frederick Bowhill, then C.O. at the station, the club soon became one of the most noted in Egypt. The club team could be found in all the principal events at Alexandria, Cairo and the Canal area, and competed against such bodies as the Royal Yacht Club of Egypt and the British Sailing Club. Facilities included a well-equipped boathouse and workshop in Aboukir Bay, the club being registered with the Yacht Racing Association. In 1946, 30 boats, mostly Snipes, were registered.

Battle of the Atlantic

THE official account of the fight against the U-boats during 1939-1945, written by Capt. H. T. Dorling, R.N. ("Taffrail"), and prepared for the Admiralty and the Air Ministry by the Central Office of Information, is now available under the title of "The Battle of the Atlantic," price one shilling.

The battle raged 68 months from the sinking of the *Athenia*, within a few hours of the declaration of war, to the signal by Doenitz ordering the cessation of hostilities. Until the very end the German U-boat arm fought with discipline and efficiency and only the night before surrender sank two of our merchant ships. The U-boats nearly succeeded and the war against them was one of the most vital, protracted and bitterly fought sea and air campaigns in which Britain and her Allies have ever been engaged.

When war broke out Germany had fifty-seven operational modern U-boats and at the end of 1942 the number, with the Italians, was 485. Against this armada our principal instrument was the ASDIC detecting device, and we had some 200 vessels equipped with it in 1939. Aircraft as a method of fighting

submarines had hardly come into the picture, nor were escort carriers in being. The increasingly important part played by aircraft is well illustrated in this fine book.

Hat-trick at Habbaniya

OFFICERS and men of R.A.F. Habbaniya turned out in force to see Group Capt. H. H. Brooke, D.F.C., ride two of his own horses to first place at the opening meeting of the Habbaniya Turf Club last month. Another of the Group Captain's horses gained first place, to complete his hat-trick for the day.

U.S.A.F.E. Thank R.A.F.

THE following message has been received by the Air Officer Commanding-in-Chief, R.A.F. Bomber Command (Air Marshal Sir Norman Bottomley) in connection with the search in the Alps for the missing United States Dakota aircraft:

"United States Air Forces in Europe wish to state their deep appreciation of Bomber Command services in finding the crashed aircraft, and for the hard work put in on the job."

The following message has also been received from H.Q. U.S.A. Air Forces in Europe by the A.O.C.-in-C. R.A.F. Transport Command (Air Marshal Sir Ralph A. Cochrane):

"We wish to express deep appreciation of your prompt action in sending a glider to assist in the search for the U.S. Dakota, and for your co-operation from the beginning."

Meteor Air-brakes

MANY scores of published dissertations on the Gloster Meteor have by no means exhausted the "newsworthiness" of this most remarkable of all jet fighters, now in production for the R.A.F. in its structurally stiffer and more manœuvrable clipped-wing form.

It is not yet fully appreciated, for example, that the air brakes are necessary for three reasons: (1) To enable the aircraft to descend quickly without exceeding the design limitations of speed and Mach No. (600 m.p.h. I.A.S. and 0.85); (2) to steepen the dive when attacking ground targets; and (3) to reduce speed quickly during approach to an aerial target. The last-named ability, of course, is particularly important at night.

The makers claim that a Meteor has been put into a 70-degree dive at 32,000ft, with the Derwents turning at 97 per cent max. r.p.m., and a descent made to 4,000ft in about a minute without exceeding design limitations.

It is stated, moreover, that the deceleration produced by closing the throttles and operating the brakes is about 60 per cent of the acceleration due to gravity at 400 m.p.h.

The brakes can be selected "open" at any speed up to 600 m.p.h. I.A.S., a relief valve in the hydraulic system precluding the possibility of overstressing the structure. The brakes cause only negligible change in lift and trim and the pilot is able to keep his sights on the target. About 1½ seconds are required for the brakes to extend fully.

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Biggin Hill Chapel Destroyed

IN the early hours of December 3rd, the St. George's Chapel of Remembrance at R.A.F. Station, Biggin Hill, was destroyed by fire. The Chapel was built as a memorial to pilots killed in the Battle of Britain and the screen bearing the names of two hundred dead and missing pilots was destroyed, together with the Book of Remembrance, in the fire.

R.A.F. Housing Exhibition

THE Secretary of State for Air, Mr. Noel-Baker, opened an R.A.F. Housing Exhibition at the showrooms of the Bristol Aeroplane Company in Piccadilly on December 3rd.

In the specimen married quarters everything, from electric labour-saving devices to fifty clothes pegs and a set of meat carvers, is provided. Mr. Noel-Baker said: "The principle has been accepted that both the accommodation and the household amenities provided for the airman and his family should be at least equal to anything offered in comparable circumstances in civil life." He stated that in 1939 the R.A.F. had 6,556 married quarters, many of which had been appropriated for other purposes. Already 4,500 had been renovated and occupied and 1,300 were being reconstructed and would shortly be in use. It was hoped to build a thousand additional married quarters during 1947 and to provide more quarters for junior officers who wished to get married. A new type of barrack block was being introduced, with single cubicles for N.C.O.s and elder men, and rooms for four. Twenty-three new barrack blocks would be provided at home during 1947 and more would be built abroad.

SOUVENIR SPITFIRE: A Spitfire I, flown in the defence of London by 609 (West Riding) Squadron, is one of the exhibits in the Imperial War Museum, Lambeth Road, London, now reopened. The museum suffered severely during the war.

Picture-story of Airborne Troops

A COLLECTION of photographs showing airborne troops in training and in action has been published under the title *Airborne* by the Airborne Forces Security Fund, 70, Eaton Place, London, S.W.1.

R.A.F. Passenger Casualties

AN official Air Ministry return of accidents involving casualties among passenger and troop-carrying aircraft of the R.A.F. during October, 1946, shows that two accidents involved death or injury. Seven aircrew were killed and five injured. Passengers killed and injured were seventeen and five respectively. The return covers about 13,500,000 passenger-miles and relates to scheduled services, special flights and troop movements carried out by Transport Command and other Commands of the R.A.F.

Casualties

THE Air Ministry regrets to announce that a number of R.A.F. personnel were killed and injured as a result of a Boston belonging to the Torpedo Development Unit of the Ministry of Supply striking a public omnibus on the road adjoining Weston-super-Mare Airport while approaching to land on November 22nd, 1946.

The list of the casualties is as follows:—

KILLED.—A/C.2 E. W. Bellamy, A/C.2 J. I. Davis, A/C.2 J. Halliday, A/C.2 E. Jackson, A/C.2 R. Lawton, A/C.2 E. H. Pearson, A/C.2 F. Wilson. DIED FROM INJURIES.—A/C.1 S. Fairweather. INJURED.—A/C. T. E. Ford, A/C.1 J. Allen, A/C.1 E. Briggs, A/C.1 J. W. Southgate, A/C.2 C. D. Carter, A/C.2 N. J. Cooke, A/C.2 J. Hawksford, A/C. F. Tay.

The next of kin have been informed.

R.A.F. School of Arts and Crafts

ARTS and crafts education in the R.A.F. has proved so valuable that it is to continue as part of the educational scheme for the post-war Service. This was announced by Air Vice-Marshal Sir Brian Baker, Deputy Air Commander-in-Chief, MED/ME, in his speech, opening the exhibition of the R.A.F. School of Arts and Crafts, Heliopolis, Cairo. A.V-M. Baker, reviewed the growth of the school from its beginning with a group of enthusiasts at Midan Ismailia, Cairo, in January last year.

The work of the school, he said, had been throughout under the supervision

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of Sqn. Ldr. A. G. Lamberth. Until June this year, instruction had been voluntary, but now there was a course of full-time students from all over the Command who came to study for a month. The present course numbered 120, and five hundred more attended the school in the evenings.

A.V-M. Baker was accompanied by Lady Baker, and other guests at the opening reception included A.V-M. S. F. Toomer (A.O.C. 219 Group) and Mrs. Toomer; and A.V-M. Sir William Havers.

Works exhibited included painting, sketching, mechanical and architectural drawing and modelling and craft work, including toys made by German P.o.W.s on the staff of the school.

Reunions

IT is proposed to hold a reunion dinner in London on a Friday night in mid- or late February for officers of H.Q. 221 Group and of units associated with that formation in the Burma campaign.

Officers who are likely to attend the dinner are requested to advise Flt. Lt. L. W. Stavers, H.Q. Fighter Command, R.A.F., Bentley Priory, Stanmore, Middlesex, before December 23rd.

* * *

It is also proposed that a reunion dinner for officers (past and present) of the R.A.F. Regiment who served in the area of command of Air Command South East Asia prior to the termination of the war with Japan shall be held in London at a date early in 1947. Those interested should communicate with Wing Cdr. E. A. Barton at No. 79, Cadogan Gardens, London, S.W.3, who will forward details of the proposed arrangements.

* * *

A reunion dinner of 26 O.T.U. R.A.F. Wing has been arranged and all interested are asked to communicate with Donald Becker, "Torrington," St. Mary's Road, Ditton Hill, Surbiton, Surrey.

* * *

A very successful reunion dinner for officers who served at R.A.F. Station Ford was held in London last week. Wing Cdr. Gerald C. Maxwell, M.C., D.F.C., A.F.C., who commanded the Station from 1941 to 1945 was in the chair and over eighty officers attended. This Ford reunion is to be held annually on the last Friday in November and particulars can be obtained from the Joint Secretary, Squadron Leader A. B. Carter, The Oriel, Barnham, Sussex.

* * *

At the Londesborough Hotel, Selby, on Saturday, January 4th, 1947, 578 Burn Association will hold its annual reunion dinner. Full details can be obtained from Mr. M. Clark, 20, Chapel gate, Retford.

Polish Resettlement

ONE of nine Royal Air Force stations earmarked for use by the Polish Resettlement Corps, R.A.F., the former airfield at Melton Mowbray, Leicestershire, is to accommodate the dependent families of Polish airmen and officers who are being resettled in civilian life by Britain.

The first contingent of about 270, mostly women and children, arrived at the station on November 26th, by special train from Tilbury Docks. They sailed from Cuxhaven the previous Sunday. Further batches expected to reach the camp from the British zone of Germany at fortnightly intervals will bring the total number of Polish civilians to 700 by Christmas. Later a small number will come from the Middle East and there will be others who have already arrived at R.A.F. stations in this country from Italy.

The Polish Resettlement Corps, R.A.F., was formed because service alongside British units tended to give the Polish Air Force a separate identity from the Polish Army. The Corps is a non-combatant component of the R.A.F. There is a small supervisory staff of British officers and airmen, and at Melton the station commander is Wing Commander T. R. Vickers, D.S.O. There are about 50 British service personnel on the station. A Polish permanent staff of some 250 officers, airmen and airwomen have been preparing the camp and will help to keep the daily life running smoothly.

In the past the Melton airfield has served as a ferry pool, a fly-off base for airborne troops who fought at Arnhem, and latterly as a recruit centre until last September. It is the only R.A.F. station in the country now to accommodate the families of Polish Air Force officers and airmen.

ROLL OUT THE BARREL: R.A.F. personnel shift 45-gallon drums of high octane petrol from a blaze in a 500,000-gallon dump at Iwakuni, Japan. They cleared a way for R.A.F. firemen, enabling more than three quarters of the spirit to be salvaged.

Award

THE KING has been graciously pleased to approve the following award:

B.E.M. (Mil.)

Flight Sergeant William George Statham, R.A.F.V.R., No. 109 Sqn.

Privileges Restored and Extended

AS already announced, Air Officers Commanding-in-Chief have been informed by the Air Council that the time has come to restore certain pre-war customs and privileges affecting the day-to-day life of officers and airmen and to modify other conditions of Service life so that all ranks, when off duty, may enjoy liberties and privileges as near as possible to those enjoyed by men and women in ordinary civil occupations.

Privileges now renewed or extended include such matters as sleeping out, the wearing of plain clothes, a simplified system to avoid the necessity of issuing short passes, admission of visitors to Stations, free association of N.C.O.s and airmen when off duty and the reduction of certain parades. Details follow.

Parades.—Parades for such routine processes as clothing issues, meals and medical attention should not now be necessary. With the same end in view, changes in the system of paying airmen are now being examined. When a parade is necessary, personnel should never be fallen in earlier than is essential.

The routine of a Station can never be allowed to approximate to that of a factory because the R.A.F. is a Fighting Service and must be trained and disciplined to withstand the special stresses of a Fighting Service in war. As men in the Service do not "clock-in," the roll must be called at appropriate times, and it is usually quicker and more efficient to march men, rather than to let them straggle individually to work.

When deciding whether or not it is necessary or desirable to hold a parade, or to fall men in and move them as a body, the yardstick to be applied is whether this is necessary in the interest of training, technical efficiency, discipline, or economy of time or effort.

Request Hours.—A system of regular "Request Hours" should be arranged for two kinds of matters, viz., those concerning the Station or Unit, and confidential personal matters. Complaints will still go through the normal channels and no criticism of individuals will be allowed at these Request Hours.

Off-Duty Privileges: Airmen.—As a general policy, restrictions while airmen are off duty should be abolished except in so far as they are necessary for the good of the community as a whole. To this end, sleeping out privileges should now be fully restored, and in addition a permanent pass may now remain valid indefinitely, unless withdrawn by the C.O., and need not be restricted to any particular area.

Some form of signing-out should be considered instead of short passes, which

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may now be abolished except for leave and when leaving the Station during normal working hours. This does not mean that unmarried personnel may live out of camp, which would not be in the best interest either of the Service or of the individual, especially in view of the civilian housing shortage.

Outside camp, airmen and N.C.O.s may mix without restriction. Within the Station C.O.s may make whatever regulations are necessary on this subject.

Airwomen.—Existing rules will continue to apply to airwomen.

Visitors. — Airmen and airwomen should be allowed to invite visitors to their Stations and entertain them in rooms set aside for this purpose. It has already been announced that the airmen's clubs will include visitors' rooms; meanwhile existing accommodation can be adjusted to provide suitable facilities.

Plain Clothes.—Since November last year airmen and airwomen have been allowed to wear plain clothes outside the Station.

Now, both at home and abroad, airmen and airwomen may also be allowed to wear plain clothes when off duty, on or off the Station, as soon as the coupon situation permits. This privilege does not apply to recruits and apprentices.

Pending the general introduction of an off-duty dress for the W.A.A.F., airwomen may be allowed to wear plain clothes at Station dances, but generally at organized Stations entertainments (whist drives, dances, etc.) "best blue" will be worn.

All ranks may attend the church services at the Station in plain clothes, except on special occasions at the C.O.'s discretion.

In Commands abroad where active service conditions prevail the A.O.C.-in-C. or A.O.C. may make local regulations in conformity with these general principles to suit local conditions, but they should not be less favourable than those of other Services in the same locality.

Inspections. — Inspections by Air Officers commanding-in-Chief and Group Commanders should be re-introduced. A series of antecedent inspections at Squadron, Station and Group levels should be avoided, and apart from the one annual inspection, Commanders and staffs should normally carry out inspections informally.

Station Commanders should resume the inspection of quarters once a week.

Formal inspections on the lines held before the war are of great value in raising the standard of discipline and efficiency throughout the Service.

Drill. — The implications of drill and its true meaning are to be clearly presented to all ranks, so that it will not be regarded as an anachronism or punishment.

Physical Fitness. — Commanding Officers must remember that they have a general responsibility for the health of their men. To this end, regular physical training for all personnel is to be regarded as fundamental.

ROCKET TEMPEST: A Hawker Tempest VI with zero-length R.P. rails. The Tempest II (Centaurus), V and VI (Sabre) are extensively used for ground-attack in the R.A.F., having succeeded the most famous of all rocket-firing aircraft, the Typhoon

Combat Training.—All airmen must be given training under their own officers and N.C.O.s with the aid of the R.A.F. Regiment in day and night ground combat. Such training is essential to the R.A.F. as a Fighting Service and will help to develop leadership and discipline.

Responsibilities of Junior Officers.—It is to be made clear to all permanent officers from the outset of their careers that "man-management," or the handling of men, is "the basis of leadership and a primary purpose for which they are granted the King's Commission." The aim is that every airman should know that there is a particular officer to whom he can turn for friendly help and advice, whether on a private or Service matter. Conversely, the officer is to realize that he has responsibilities of this sort towards a specific group of men in whom, as a normal part of his job, he is to take a personal interest.

This will be achieved by specific training in man-management during officer training, after which it will be the responsibility of senior officers to train their juniors in this subject. At various stages of his career, an officer will fill posts in which these responsibilities are particularly pronounced and varied so that he will become fully experienced in all aspects of the problems involved.

Officers will have full opportunities of learning and practising administration.

Improvement of status of Warrant Officers and N.C.O.s.—Measures under consideration to improve the status of Warrant Officers and N.C.O.s cannot become fully effective until conditions in the Service are more settled. Meanwhile Cs.-in-C. are to do what they can to help W.O.s and N.C.O.s to retain their pre-war prestige and standards of efficiency.

Aircrew.—A very high standard of bearing and discipline will be required from aircrew to ensure that their authority and prestige reach their full measure of influence in the Service.

Dress, turnout and saluting.—Immediate improvement in these directions must take place at once, and the first essential is for officers and N.C.O.s to set a proper example. As redesigned uniforms cannot be available for some time, it is impossible to wait for them before insisting on drastic improvements in present-day standards of dress.

Station Committees.—Cs.-in-C. should consider the introduction on their Stations of Station Committees, consisting of representative officers and men under the chairmanship of the Station Commander, to deal with all aspects of Station life.

This might at first seem revolutionary, but the Air Council consider that nothing but good could come from holding committee meetings at which all ranks would feel that, through their representatives, they have a share in the general running of their Station. The Committee could provide a means for bringing up airmen's suggestions, and, on the other hand, for explaining to the men why certain orders and measures have been given or introduced. Minutes of meetings will be kept and displayed for airmen to read.

Officers' and Sergeants' Messes.— Everything practicable should be done to regain pre-war standards of mess discipline as an important factor for inculcating a proper sense of discipline and self-respect.

Badge of No. 31 Squadron, R.A.F.—Motto: In Caelum indicum primus. (First into Indian skies).

Badge of No. 527 Squadron, R.A.F.—Motto: Silently we serve.

Badge of No. 500 Squadron, R.A.F.—Motto: Quo fata vocent. (Whither the fates may call).